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NOTE

LEFT FIELD SUPERIORITY FOR WORD MATCHING*

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Abstract—Subjects asked to match a word presented in one visual field to a previously exposed word presented across the fields demonstrated higher accuracy for words in the left visual field. This result is contrary to existing views of right field superiority in word recognition. The left field superiority suggests that word recognition is a multistage process and cannot be considered to be invariably handled more efficiently and accurately by the left hemisphere.

INTRODUCTION

NUMEROUS studies have compared the relative accuracies of the right and left visual fields in recognizing tachistoscopically presented verbal material. With few exceptions (HERON [1]; FORGAYS [2]) the results have found more accurate word recognition in the right visual field (for review, see WHITE [3]). Recently, the trend has been to attribute field dependent perceptual effects to the underlying organization of the half brain to which the field primarily projects. Verbal material is handled more accurately and efficiently when presented to the right field/left hemisphere which is the major language processing and speaking hemisphere (GAZZANIGA [4]), and the complementary finding has been that the left field/right hemisphere is more adept at handling spatially related material (GEFFEN [5]; GIBSON [6]; KIMURA [7], [8]; KLATZKY and ATKINSON [9]; RIZZOLATTI [10]).

Although it is clear that word recognition relies heavily on language related processing, it also seems that much detailed spatial analysis must be utilized in at least the early stages of word recognition. Since the right hemisphere is credited with being able to handle spatial characteristics more adeptly than the left hemisphere, it would seem that the left field should be more accurate for word recognition under certain conditions. An alternative view is that perhaps there is no general spatial ability and that the left hemisphere has a special ability to detect spatial configurations characteristic of verbal material, while the right hemisphere is better at handling spatial configurations peculiar to faces, geometrical shapes and the like. A still more economical explanation might be that both hemispheres work together in the handling of complex stimuli and procedural variables sometimes emphasize the contribution of one hemisphere more than the other thereby producing a corresponding field difference.

The present experiment attempted to manipulate the relative amounts of language related and non-language related processing necessary to perform two tasks utilizing word stimuli. The first task, which was designed to minimize reliance on language, required the subjects to make a manual response indicating a match or mismatch to two sequentially presented words. The second task utilized the same word stimuli, but the subjects were required to read aloud the words as they were presented.

METHOD

Subjects

A total of 10 graduate and undergraduate students from New York University were tested. The subjects had not been used in similar experiments and were not informed of any theoretical aspects related to the study. All subjects used their right hands for writing and stated that they were right handed.

Stimuli

The stimuli were pairs of commonly occuring three and four letter nouns and verbs chosen from the Thorndike–Lorge word count. Both words of each stimulus pair were either three or four letters long.

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Words were randomly chosen for pairing, and pairs that happened to have obvious associations were excluded. The first word of a stimulus pair was projected across the visual fields subtending a visual of angle 12 degrees in length and 2.5 degrees in height. The smaller second word of each pair subtended a visual angle of 4 degrees in length and 0.75 degrees in height and was presented so that the nearest letter was always 1 degree to the right or to the left of the 0.2 degree fixation point. The stimuli were presented in the same order for all subjects.

Procedure

Subjects were instructed to sit in a soundproof booth with their foreheads against a rest and to fixate the dark central point at all times. One word was then exposed in large letters across the visual fields for a period of three seconds. The large size and long exposure insured that the subjects were able to read the first member of each pair with little difficulty. One half second later the smaller word was exposed for 40 msec to either the left or right of fixation. The subjects task was to press a key with the index finger of one hand to indicate a positive match between the first and second words, and to press another key with the second finger of the same hand to indicate a negative match. One half of the subjects were instructed to use their right hands and one half to use their left hands. At the conclusion of 80 trials (one half positive and one half negative matches) the subjects were run through the stimuli again, but this time they were instructed to read aloud the second member of each pair and gave no manual response.

One half second before each stimulus presentation a short warning beep sounded in the subjects' earphones which normally presented white noise. The headset also contained a crystal microphone which provided communication with the experimenter.

At the same time as the warning beep, a motor was pulsed to spin a polarizing filter in front of a projector with a #47 Wratten filter which provided background illumination. This produces an effect known as Haidinger's Brush, a small revolving shadow due to a polarization sensitive area at the center of the fovea.* Subjects were instructed to keep the vortex of the brush spinning around the fixation point, and if it was not to correct their gaze.

RESULTS

Table 1 presents the results of the first task in terms of percent correct. All ten subjects demonstrated a higher accuracy for recognizing words presented to the left visual field ($p<0.01$). No significant difference was found between positive and negative matches or for the interaction between the match and field.

Table 1. Percent correct matches for Task 1

	Left field	Right field	M1
+ Matches	83%	70%	76%
− Matches	86%	75%	81%
M1	84%	73%	200/cell
	$F_{LR}=52.4$	df 1, 9	$p<0.01$
	$F_{+-}=1.4$	df 1, 9	N.S.
	$F_{LRX+-}=1.4$	df 1, 9	N.S.

During the second task the *S*'s proved unable to give a verbal report when the same intensity levels were used as in the first task. The first subject was run entirely at the same intensity level and was unable to make any correct verbal identifications of the second word of a pair. When it was discovered that the other subjects also could not make verbal reports at the low intensity level, the intensity was increased to allow partial report. Since this was not done for the first subject, his data was dropped from the analysis of variance.

The verbal report also proved to be more accurate when the word was presented to the left visual field ($p<0.01$, see table 2). The recognition trials prededed by the same word (positive matches in Task 1) were recognized signigicantly more frequently ($p<0.01$) than the trials preceded by different words (negative matches in Task 1). The interaction between field and same word/different word proceded trials was not

* We wish to thank Dr. Lloyd Kaufman for bringing this effect to our attention.

significant, though the difference favoring the left field was much larger and more reliable for the trials preceded by the same words.

Table 2. Per cent correct verbal recognitions for Task 2

	Left field	Right field	M1
Preceded by same word	80%	64%	72%
Preceded by different word	41%	37%	39%
M1	60%	51%	180/cell
	$F_{LR}=13.3$	df 1, 8	$p<0.01$
	$F_{same/diff}=31.7$	df 1, 8	$p<0.01$
	$F_{AXB}=1.6$	df 1, 8	N.S.

DISCUSSION

If one is willing to accept that field differences do reflect cognitive–perceptual abilities of the contralateral cerebral hemispheres, then it can be said that the match procedure successfully favored the right non-speaking hemisphere. The verbal report also favored the left field contrary to previously published data finding right field superiority for verbal word recognition (ORBACH [11]; MCKEEVER and HULING [12], [13]). In the case of verbal trials preceded by the same word, it can be argued that the subjects were performing the matching rask on perceptual-spatial aspects, as in the first part of the experiment. That is, a decision is made whether the quick flashed word is the same as the match on some kind of perceptual dimension, and, if so, the subjects then make a verbal report from memory of the large easily read first word. This sort of strategy would predict a higher accuracy in the left, spatially superior field for the trials preceded by the same word (as in Task 1). In addition the model would predict no facilitation for different words, since the knowledge of a mismatch would not help give a verbal report of the second word. The data supports these two predictions.

The fact that subjects were unable to give verbal reports of words which they were able to match indicates that different processes are involved, and it is likely that the match can be made on basic perceptual and spatial characteristics which represent an early stage in word processing (POSNER [14], 1969). It could also be that the match situation relies on a strategy not used in normal word recognition. In either case, the hypothesis described above that spatial abilities may be specialized for different types of stimuli (left-verbal; right-perceptual) in the hemispheres is not supported.

Treating a word as a verbal stimulus would seem to be justified only when the task stressed language related properties. Whether or not a right field superiority will manifest itself is not dictated by the stimulus alone but appears to also depend upon the interaction of task and stimulus. In future work it may be more profitable to consider words complex stimuli whose processing is not exclusively the domain of one hemisphere.

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Résumé—Chez des sujets à qui on avait demande d'apparier un mot présenté dans un hémichamp visuel à un mot antérieurement exposé à travers tout le champ visuel, on constatait une exactitude supérieure des appariements pour les mots présentés dans le champ gauche. Ce résultat contredit le point de vue selon lequel existe une supériorité du champ droit pour la reconnaissance des mots. En raison de cette supériorité du champ gauche on suggère que la reconnaissance du mot est un processus à stages multiples et qu'on ne doit pas considérer que cette reconnaissance est invariablement réalisée de façon plus efficiente et plus exacte par l'hémisphère gauche.

Zusammenfassung—Versuchspersonen wurden gebeten, Wörter die im linken Gesichtsfeld dargeboten wurden, mit vorausgegangenen Wörtern im gesamten Gesichtsfeld dargeboten, zu vergleichen. Dabei ergab sich eine größere Wortgenauigkeit für Expositionen im linken Gesichtsfeld. Dieses Ergebnis steht im Widerspruch zu der bisherigen Auffassung einer Dominanz des rechten Gesichtsfeldes für Worterkennen. Die linksseitige Feldüberlegenheit spricht dafür, daß das Erkennen von Wörtern auf einem vielfältig bestimmten Vorgang beruht und daß man nicht davon ausgehen darf, daß es sich bei der Leistungsstärke und Präzision der linken Hirnhälfte um eine Invariable handelt.