Selective attention: Superior detection of word targets compared with sound targets in a prose passage while shadowing another passage

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Ss shadowed a prose passage delivered to the right ear and were asked to tap to occurrences of a target in a second passage delivered to the left ear. Group 1 was asked to tap to a sound that could also be two different words (e.g., I and eye), Group 2 to one of these words only. Group 2 performed better than Group 1, reversing the result of Wilding & Underwood (1968). The result is attributed to availability of contextual information for Group 2; arguments of Treisman & Geffen (1967) against such availability are rejected.

Wilding & Underwood (1968, henceforth called Experiment A) found that when Ss shadowed prose delivered to one ear and tapped to targets in a passage delivered to the other ear, detection declined from sound targets (Group 1) to words (Group 2) and from words to classes of words (Group 3). This result was taken to refute the theory of Deutsch & Deutsch (1963) that all inputs are fully analyzed before selection occurs, and to weaken Treisman's (1964) theory that selection occurs after sound analysis and before meaning analysis. Groups 1 and 2, however, differed in the number of phonemes to be identified and Groups 2 and 3 in the number of different target words that might occur. Even if all stages of analysis occur after the filter, as indicated by Treisman & Geffen (1967, Fig. 1a), the above result is predicted by the system of a series of decision criteria postulated by Treisman (1964, 1966) for language identification. It is not apparent why Treisman assumes single phonemes are processed after the filter but brief tones before it (as shown by Lawson, 1966). Since differences between voices are processed before the filter (Treisman, 1964), complexity of the stimulus dimension is not the criterion.

Experiments B(1) and B(2), which are reported here, repeated the conditions of Groups 1 and 2 of Experiment A, but used sounds that can also be two different words. More complex homophones might have been used, like those used by Treisman & Geffen (1967), but these would have required complex analysis even by Group 1. Word identification normally involves combining phonemes, though the process is unlikely to be simply additive and sequential, but in this case no such combining was required of Group 2 that was not required of Group 1. To perform successfully, however, Group 2 did need to analyze context sufficiently to discriminate the homophones, and it was assumed that any difference between the two groups could be attributed to this process. Word identification may involve some other process additional to sound analysis, but no account has been offered of any process other than the two discussed. Analysis of context was assumed to involve both syntactic structure and semantic content. If analysis of context is normally performed, Group 2 should benefit more than Group 1; such analysis will directly aid in anticipating forthcoming words, but additional processing would be required to enable anticipation of forthcoming sounds. If context is not analyzed, or if such analysis imposes an additional burden, Group 2 will do no better than Group 1 and may do worse. Moreover, Group 2 will make false positive responses to homophones of the target word if context is not analyzed.

Treisman & Geffen (1967) argue strongly that the semantic content of an unshadowed message in this situation is not analyzed. In one of their experiments, targets in context in the secondary passage were detected better than those not in context only when the targets in the primary passage were also in context. They argue that since the same target words were used in both passages, the general themes tended to be similar when targets were in context in both passages; hence, in this condition, primary-passage context could aid target detection in the secondary passage. A simpler explanation is that detecting targets in context in the primary passage is easier than detecting them out of context, enabling better analysis of context in the secondary passage when the targets are in context in the primary passage.

A second argument of Treisman and Geffen is that Ss failed to distinguish homophones in the secondary passage, since as many responses were made to them as to the correct target. This comparison, however, is made between conditions that also differ in another important respect and is, therefore, invalid. The detection rate for correct targets is from conditions where such targets always occurred in both passages; the rate of false positive responses to homophones is from conditions where Ss were asked to tap to a target word, but *only* its homophones occurred in the secondary passage.

Thirdly, Treisman and Geffen argue that, since tapping to any one of four homophones in the secondary passage was as easy as tapping to a single target word, context was not analyzed. Why analysis of context should have produced a difference between these conditions is not stated; moreover, Ss might revert to a sound-detection strategy in the multiple-target situation. Thus, the arguments that context is never analyzed in the unshadowed passage do not establish the case.

METHOD

The method was as indicated above and as described in Experiment A, with the following modifications. Separate portable tape recorders were used for the two passages, instead of a single two-track recorder, to enable random variation of the temporal relation between passages. Miniature earphones were used instead of a split headphone. The passages were modified extracts from *Far from the Madding Crowd* by Hardy. Three different secondary passages were devised: In one the target was [aI] (I/eye), in another [ju] (you/ewe), and in another [o] (oh/owe). In Experiment B(2), the passages were rerecorded without emphasis or punctuation as far as possible, and instructions to Group 1 were given twice and emphasized to ensure that poor performance was not due to failure to comprehend the task.

Twenty-four Ss took part in each experiment, 12 being assigned randomly to each group. Within groups, four were assigned randomly to each secondary passage (i.e., target sound), and in Group 2 two of the four Ss were assigned to each homophone. The target word in a practice passage was "fire." Instructions paralleled those given to Groups 1 and 2 in Experiment A; the target word was spelled for Group 2.

RESULTS

The mean number and percentage of targets detected and range of scores for each target are shown in Table 1.

By the design, Ss had been assigned at random to matched pairs, one in Group 1 and the other in Group 2. The number of times that the S in Group 1 detected the

Table 1

Mean Target Detection Rate Out of Four Targets in the Unshadowed Passage. Percentage Correct, and Range of Scores. The Group 1 mean is from four Ss in each case and the Group 2 mean from two Ss in each case.

	Experiment B (1)						Experiment B (2)					
	Group 1			Group 2			Group 1			Group 2		
	Mean	% Correct	Range	Mean	% Correct	Range	Mean	% Correct	Range	Mean	% Correct	Range
I	0.25	6.0	0–1	2.50	62.5	2–3	0.25	6.0	0–1	1.50	37.5	1–2
Eye	0.50	12.5	0–2	0.50	12.5	0–1	0.00	0.0	0	1.50	37.5	0–3
Oh	0.25	6.0	0–1	1.50	37.5	1–2	0.00	0.0	0	0.50	12.5	0–1
Owe	0.25	6.0	0–1	1.50	37.5	1–2	0.00	0.0	0	0.50	12.5	0–1
You	0.50	12.5	0–2	0.50	12.5	0–1	0.50	12.5	0–1	1.50	37.5	1–2
Ewe	0.25	6.0	0–1	1.00	25.0	1	0.50	12.5	0–1	1.50	37.5	1–2
Mean	0.33	8.0		1.25	31.0		0.21	5.0		1.20	29.0	

word that was the target for the S in Group 2 was counted, and a sign test was used to compare the groups. In Experiment B(1), the S in Group 2 performed better in 10 of the 12 comparisons, with one tie ($p < .04$ on a two-tailed test, counting the tie against the trend). In Experiment B(2), 8 of the 12 comparisons favored Group 2, with four ties ($p < .04$ on a two-tailed test, dividing the ties for and against the trend). No significant differences appeared between results for Experiments B(1) and B(2).

DISCUSSION

The result implies some appreciation of context in the secondary passage. The absence of false positive responses in Group 2 confirms this. One occurred in Group 1 in Experiment B(1) and one in each group in Experiment B(2).

The reverse result of Experiment A may be attributable to the increased number of phonemes that Group 2 had to process compared with Group 1 in that experiment, but complete reconciliation of the two sets of results is not easily achieved, since the big difference between Experiment A and Experiment B lies in the performance of Group 1. Group 1 performed much worse in Experiment B than in Experiment A (6.5% detections compared with 45%); the primary passage may have been more demanding or the signal of poorer quality; the sounds used were different and were words rather than parts of words. However, the first two of these factors, which are those most likely to have had an adverse effect, were also present for Group 2, yet Group 2 performed better in Experiment B than in Experiment A (30% against 20% detections). Neither the greater phonemic simplicity of the targets nor the use of passages consisting in part of dialogue (which might provide more contextual cues) in Experiment B seems to to explain this fact. Such factors seem unlikely to have outweighed the adverse factors specified above. Moreover, there is some evidence against their having any effect; a more phonemically complex target ("fire") in the practice run in Experiment B was detected as often as the other word targets in Experiment B (34% times), and reading the passages without expression in Experiment B(2) had no apparent effect on detection rate. There is thus no ready explanation for the simultaneous decline in performance of Group 1 and improvement of Group 2 in Experiment B compared with Experiment A. Obviously several variables require further study in this type of situation; in particular an investigation is required of differential effects of variables, such as those discussed above, on the sound-detection and word-detection tasks. Another urgent need is for some index of the difficulty of the passage to be shadowed and of performance in shadowing.

Given that all processing of speech occurs after the selective filter, as Treisman & Geffen (1967) suggest, the present results enable no decision between the theories of Treisman (1964) and of Deutsch & Deutsch (1963) concerning the site of the filter. The comparatively good performance of Group 2 is more compatible with the latter theory, but, since Deutsch and Deutsch do not specify the processes that occur before selection, they cannot predict the difference between Groups 1 and 2. Treisman might predict the reverse result to that obtained, but in fact her theory is not sufficiently precise to make any definite prediction. To enable it to handle these results, at least two modifications are required.

First, the results for Group 2 compared with those for Group 1 suggest that knowledge of the meaning in a secondary passage is not just restricted to cases where the stimulus captures attention because the threshold for it is low. Second, a more precise specification is required of the theory of speech perception as a series of stages of analysis, proceeding from single phonemes, by progressive integration of units into larger wholes, to appreciation of meaning. As it stands, this theory cannot predict whether it will be easier for a listener to detect targets specified in terms of information extracted early in this process or targets specified in terms of information extracted late in the process.

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