ATTENTION IN DICHOTIC LISTENING: AFFECTIVE CUES AND THE INFLUENCE OF INSTRUCTIONS

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In shadowing one of two simultaneous messages presented dichotically, subjects are unable to report any of the content of the rejected message. Even if the rejected message consists of a short list of simple words repeated many times, a recognition test fails to reveal any trace of the list. If numbers are interpolated in prose passages presented for dichotic shadowing, no more are recalled from the rejected messages if the instructions are specifically to remember numbers than if the instructions are general: a specific set for numbers will not break through the attentional barrier set up in this task. The only stimulus so far found that will break through this barrier is the subject's own name. It is probably only material "important" to the subject that will break through the barrier.

INTRODUCTION

Cherry (1953) introduced the method of "shadowing" one of two dichotic messages for the study of attention in listening, and found that subjects who shadowed a message presented to one ear were ignorant of the content of a message simultaneously presented to the other ear. By "shadowing" is meant that the subject, while listening to a continuous message, repeats it out loud at the same time. The first experiment was to test more rigorously Cherry's findings.

METHOD

In all the experiments the apparatus used was a Brenell Mark IV stereophonic tape-recorder modified with twin amplifiers to give two independent outputs through attenuators, one output going to each of the earpieces of a pair of headphones. Matching for loudness was approximate, by asking the subjects to say when two messages that seemed equally loud to the experimenter were subjectively equal to them. The proceedure used allows matching to within $\pm$ 1 db., a difference which has been found (Moray, 1958), to cause no significant favouring of the louder message. The subjects were undergraduates and research workers of both sexes. Before each experiment the subjects were given four passages of prose to shadow for practice. In all cases the loudness of each message was approximately 60 db. above the threshold of the subject, and the speech rate was about 150 words a minute. All passages were recorded by one male speaker.

Experiment I

A short list of simple words was repeatedly presented to one ear of the subject while he shadowed a prose message presented to the other ear. The word list was faded in after shadowing had begun, and was equal in intensity to the shadowed message. At the end of the prose passage it was faded out so as to become inaudible as the prose finished. The word list was repeated 35 times. After asking the subject to report all he could of the content of the rejected message he was given a recognition test using similar material, present in neither the list nor the passage, as a control. The gap between the end of shadowing and the beginning of the recognition test was about 30 sec. The results are shown in Table I.

TABLE I

RECOGNITION SCORES FOR WORDS FROM SHADOWED AND REJECTED MESSAGES

	Mean number of words recognized
Words presented in shadowed message	4·9 out of 7
,, ,, rejected ,, ...	1·9 out of 7
Words presented for the first time in recognition test ..	2·6 out of 7

There is no trace of material from the rejected message being recognized. The difference, however, between the new material and that from the shadowed message is significant at the 1 per cent. level. The 30-sec. delay is not likely to have caused the rejected material to be lost since words from early in the shadowed message were recognized, and the work of Ward (1937) would suggest that this pause might actually increase the score. The present findings are in agreement with those of Cherry (1953).

Although the content of the rejected message seems to be blocked gross changes can be recognized (Cherry, 1953), and there is much anecdotal evidence to suggest that in selective listening the block can be broken down by certain sorts of material. Mothers hear children crying, and it is always said that a subject will respond to his own name even though the signal/noise ration is low, as at a cocktail party (to give an everyday situation). It was decided to investigate this experimentally to find the limits of the efficiency of the attentional block.

Experiment II

Subjects were required to shadow ten short passages of light fiction. They were told that their responses would be recorded and that the object of the experiment was for them to try to score as few mistakes as possible. In some of the passages instructions were interpolated, but except in two of these cases the subjects were not warned of these. In half of the cases with instructions these were prefixed by the subject's own name. The order of presentation is shown in Table II.

TABLE II

Passage	*Instructions at start of passage*	*Instructions within passage*
I	Listen to your right ear	All right, you may stop now.
II	,, ,, ,, ,, ,,	No instructions.
III	,, ,, ,, ,, ,,	John Smith, you may stop now.
IV	,, ,, ,, ,, ,,	No instructions.
V	,, ,, ,, ,, ,,	Change to your other ear.
VI	,, ,, ,, ,, ,,	No instruction.
VII	,, ,, ,, ,, ,,	John Smith, change to your other ear.
VIII	Listen to your right ear: you will receive instructions to change ears.	Change to your other ear.
IX	Listen to your right ear.	No instructions.
X	Listen to your right ear: you will receive instructions to change ears.	John Smith, change to your other ear.

The "no instructions" passages were interpolated in the table at random. For any pair of passages with instructions that without the name was given before that with the name, as it was thought that it was less likely that the former would be heard, and hence less likely that a "set" for that particular instruction would develop before

its second presentation. Most of the subjects ignored even the instructions that were presented in the passages that they were shadowing, and said that they thought that this was just an attempt by the experimenter to distract them. The passages were read in a steady monotone at about 130 words a minute by a single male voice. They were checked with an Avometer to ensure that there was no significant increase in intensity when the subject's name was spoken. The variation was within the limits suggested by Moray (1958). The subject's responses were tape-recorded and later analysed. The subjects were students and research workers.

The results are given in Table III.

TABLE III

RELATIVE FREQUENCIES OF HEARING OF AFFECTIVE AND NON-AFFECTIVE INSTRUCTIONS WHEN PRESENTED IN THE REJECTED MESSAGE

	Affective (instructions preceded by by name)	*Non-affective (instructions not preceded by name)*
Number of times presented ..	39	36
Number of times heard ..	20	4

(pooled data for 12 subjects)

Since there were 12 subjects, and the data are pooled, there should have been 36 sets of instructions preceded by the subject's name presented in the rejected message. The discrepancy is due to three subjects who heard the instructions and actually changed over, so that the second set of instructions which would normally have been heard as part of the shadowed message were now heard as part of the rejected message. All these cases occurred in passage X. The mean number of instructions heard when presented in the rejected message was calculated, and the difference between the "names" and "no-names" situation submitted to a t test. The difference is highly significant, $t = 3{\cdot}05$, giving a level of confidence greater than the 1 per cent. level, where $t = 2{\cdot}81$. This suggests that the affective value of a message is very important in determining whether it will break through the attentional barrier in dichotic selective listening.

On only four out of the 20 occasions on which the "names" instructions were heard did the subjects actually make a change to the other message, and in one of these cases the subject spontaneously reverted to the first message without noticing. On the other occasions the subjects reported hearing the instructions when asked for introspections in between successive passages or at the end of the experiment. The relative frequencies of hearing with the different instructions are given in Table IV.

TABLE IV

Instructions	*Mean frequency of hearing instructions in rejected message for 12 subjects*
John Smith, you may stop now ..	0·33
,, ,, change to your other ear ..	0·33
,, ,, ,, ,, ,, ,, ,, .. (after pre-passage warning)	0·80 per subject

While the difference between the last class and either of the first two is not significant at the 5 per cent. level of confidence ($t_{data} = 1{\cdot}86$; $t_{0{\cdot}05} = 2{\cdot}13$) the difference does suggest that instructions might alter the set of a subject in such a way as to alter the chances of material in the rejected message being perceived. A further experiment was carried out on this point.

Experiment III

Two groups of 14 subjects were required to shadow one of two simultaneous dichotic messages. In some of the messages digits were interpolated towards the end of the message. These were sometimes present in both messages, sometimes only in one. The position of the numbers in the message and relative to each other in the two messages were varied, and controls with no numbers were also used, randomly inserted. One group of subjects was told that it would be asked questions about the content of the shadowed message at the end of each message: the other was specifically instructed to remember all the numbers that it could. The difference between the mean number of digits reported under the two conditions of set were analysed and submitted to a t test. In none of the cases, whether the score is the mean number of digits spoken during shadowing, nor in the number reported, nor the sum of these two, is the difference significant even at the 5 per cent. level of confidence. From this we may conclude that while it may be possible to alter set so as to increase the chances of material from the rejected message being perceived, it is at least rather difficult for neutral material: in the present case the numbers did not become "important" enough to break through the attentional barrier.

Discussion and Conclusions

The present results raise a problem that we may call the "identification paradox": that while apparently the verbal content of the rejected message is blocked below the level of conscious perception, nontheless a subject can respond to his own name.

Cherry's initial report on the use of dichotic shadowing described the sort of reports that subjects could give about the rejected message. They could distinguish between speech, noise and tones, could recognize clicks and gross changes in pitch such as the change from a man's to a woman's voice, etc. But the verbal content of the message was completely blocked, even to the extent of the subject being unable to say in what language the message was being spoken. Since the subjects could report as much as they did, peripheral blocking at the cochlea or cochlear nucleus such as has been artificially produced by Galambos (1955), and reported in the unanaesthetized cat by Hernádez-Péon, Scherrer, and Jouvet (1956), seems unlikely to be the full story in the present case. Such blocking could produce a failure to respond to the input to one ear, but is unlikely to cause a selective failure to respond such as is seen in the present case. It seems more likely that their mechanisms are concerned with gross switches from one modality to another such as Hernández-Péon was using in his experiments.

In the dichotic shadowing there seems to be only a selective block. It is generally held that while simple discriminations may be performed by the lower centres of the brain, the cortex is required for pattern discrimination of any complexity. Thus Sharpless and Jasper (1956) found that pitch discrimination and sound localization could be performed by a cat missing cortical areas Auditory I and II and with the medial geniculate body degenerated. But interval discrimination independent of pitch was impossible. So the present data suggest that the block in dichotic shadowing occurs at quite a high level, and that the block is central to some pattern analysing mechanism.

In this connection the work of Ingham (1957) reported in this *Journal* is relevant. He could show no evidence for a change in the absolute threshold for the perception of pure tones whether the attention was directed towards or away from the ear to which the stimulus was being presented. This result can be taken with Cherry's initial findings and those of the present writer and combined as follows. When attention is directed to one ear rather than the other there is no change in the threshold for the perception of simple stimuli, such as tones and meaningless noises. These are all treated similarly, and words are treated merely as sounds in this sense. This allows the subject to know that something has stimulated the ear whose message he rejects; it may be thought of as a general warning signal, that a sound has occurred to which the subject might need to respond. In addition to this there is a second system, concerned with pattern analysis and the extraction of verbal meaning from the stimulus input. At least some of this analysis is done below the level of conscious perception, and it is at the output side of this analyser that the block functions in dichotic listening. Certain patterns, those which are "important" to the subject, are selectively transmitted even when the block is in operation. An example of such an "important" stimulus is a person's name.

From this there follows the prediction that it should be possible to show a change in the threshold for the perception of meaning of words when the attention is directed away from the ear to which the message is presented. Such a change will not be found for simple auditory stimuli, nor for important stimuli such as a name. This prediction is being investigated.

We may conclude:

1. In a situation where a subject directs his attention to the reception of a message from one ear, and rejects a message from the other ear, almost none of the verbal content of the rejected message is able to penetrate the block set up.

2. A short list of simple words presented as the rejected message shows no trace of being remembered even when presented many times.

3. Subjectively "important" messages, such as a person's own name, can penetrate the block: thus a person will hear instructions if they are presented with his own name as part of the rejected message.

4. While perhaps not impossible, it is very difficult to make "neutral" material important enough to break through the block set up in dichotic shadowing.

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