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ABSTRACT

Retention of verbal material presented in a normal linear manner was compared to retention of the same material presented in simultaneous messages for this study. The subjects were 180 undergraduates, and each was randomly assigned to one of the nine experimental groups formed by combinations of presentation--linear, two simultaneous messages, or four simultaneous messages--and posttest condition--immediate or delayed one week. Results of analyses of the 40-item multiple choice posttest showed that learning occurred under all conditions with the greatest learning in the linear condition and the least learning with four simultaneous messages, and that the difference in amount retained among the three presentation conditions was less as the retention period was longer. Since investigation of the mean scores indicates that performance levels in the three treatment conditions became more similar as time passed, the study lends support to the hypothesis that subjects use a focusing strategy when presented with large amounts of information which initially limits learning but which aids retention. No evidence was found for ear asymmetry or ear order recall, and no significant sex differences were found. (SH)

The Effect of Multiple Channel Auditory Presentation on Learning

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Every educator is concerned with the capacity of students to process verbal information effectively. One aspect of this problem is the effect of increasing the amount of information transmitted, either by raising the rate of transmission or by increasing the alternatives (Miller, 1956). A great deal of research has been done on the first area, primarily in connection with the instructional potential of compressed speech (Friedman, 1967). The second area, use of multiple auditory channels, has also been studied by a number of researchers. (Broadbent, 1954, 1957; Bartz et al, 1967; Yntema & Trask, 1963). They have proven that people can learn from as many as four simultaneous auditory sources (Moray et al, 1965). They also found that presenting each message to only one ear (dichotic mode) produced better results than presenting each message to both ears (binaural mode) (Corballis, 1967). However, almost all of these studies used digits or nonsense syllables for the presentation stimuli. Little use has been made of meaningful messages, although the redundancy factors in meaningful connected discourse should further increase the learning of subjects in multiple channel situations (Osgood & Sebeok, 1965; Maccoby & Konrad, 1966).

Any method for improving information transmission will have direct implications for the design and utilization of instructional media. Since connected discourse is the major form of auditory stimulation used in the instructional process, this study investigated whether connected discourse could be used with mutliple auditory channels in such a way as to increase learning efficiency by decreasing the time required to learn specific material. Retention of verbal material presented in a normal linear manner was compared to retention of the same material prsented in two simultaneous messages and in four simultaneous messages. Retention was measured by an objective posttest on the presentation material which was administered immediately after the presentation or after a delay of one day or one week.

It was hypothesized that:

1. significant learning would occur under all conditions with the greatest learning in the linear condition and the least learning with four simultaneous messages, and
2. the difference in amount retained among the three conditions would be less as the retention period was longer.

Method

The presention material consisted of historical and cultural information about a non-existant country. Four independent one-minute segments of the material were recorded on audio tape, each by a different voice (sements A and D by males and B and C by females). The posttest consisted of 40 mutliple choice questions, ten on each segment of the information.

Nine experimental conditions were formed by the combinations of presentation and posttest conditions. Three presentation conditions were used: L - normal linear presentation of information segments A, B, C, D in that order; T - two simultaneous message with A followed by B in one ear and C followed by D in the other; and F - four simultaneous messages with A and B in one ear and C and D in the other. There were also three posttest conditions: I - posttest immediately followed presentation D - posttest delayed for 24 hours; and W - posttest delayed for one week.

The subjects were 180 undergraduate students with normal hearning and a native command of English. Each subject was randomly assigned to one of the experimental conditions, providing 20 subjects in each group. All instructions and stimulus material were presented on tape over stereo earphones. One half of the subjects in each group had the earphones reversed, so that the

material the "normal position" group heard in their left ears, was heard in the right ears of the "reversed position" group. This was necessary in order to compensate for an "ear order effect" tending to produce better recall of material presented to the right ear (Bartz, 1967a). The tape introduced the experiment, briefly prepared the subject for the experimental presentation and then provided the presentation appropriate to his treatment condition. Following the presentation subjects in the immediate posttest condition were given the posttest, while the others were instructed to return at the time appropriate to their delay condition. Both the presentation and posttest were administered individually in a soundproof room.

Results and Discussion

The first hypothesis was accepted. A one-way analysis of variance revealed significant differences ($P<.01$) among treatments for the immediate posttest, with linear presentation producing the best performance and four simultaneous messages producing the worst (see Tables 1 and 2). This supports Broadbent (1957) and Moray et al (1965) who concluded that, due to limitations in the perceptual mechanisms, learning would decline as more channels of transmission were used. In every posttest condition the linear presentation allowed the most learning and the four voice presentation the least;

subjects in LPI actually learned over 100% more than subjects in FPI. However, even in condition FPW, which had the lowest scores, subjects performed significantly above chance ($T = 3.895$, $P < .01$), indicated that measurable learning does occur in mutliple channel stimuls presentations.

INSERT TABLE I

Hypothesis 2 concerning the effect of delay on retention was also supported. As expected, a decrease in retention was found with increased delay for all presentation conditions. One-way analyses of variance did reveal significant ($P < .01$) differences among presentation conditions in each posttest condition (see Table 1). However, investigation of the mean scores indicates that performance levels in the three treatment conditions do become more similar as time passes. Mean scores across treatments revealed a total difference among scores of 16.0 points on the immediate posttest, 14.45 points on the 24-hour delay and only 8.95 points on the week delay (see Table 2).

INSERT TABLE 2

Table 1

Summary of Analyses of Variance

Test	df	MS	F
Two-way Analysis of Variance on Posttest Scores			
Among presentation methods	2	2669.75	143.5*
Among posttest conditions	2	334.5	17.99*
Presentation X posttest	4	71.67	3.85*
One-way Analyses of Variance on Posttest Scores			
Immediate posttest scores across presentation	2	1303.5	40.1*
Day delayed posttest scores across presentations	2	1059.4	37.1*
Week delayed posttest scores across presentations	2	448.21	25.32*
Linear presentation across posttests	2	327.8	12.7*
Two simultaneous message presentation across posttests	2	144.95	9.23*
Four simultaneous message presentation across posttests	2	3.615	.29**

* significant beyond .01 level of confidence

** non-significant at .05 level of confidence

Table 2

Means and Standard Deviations for the Experimental Groups*

Presentation Method	Immediate Posttest		Day Delayed Posttest		Week Delayed Posttest	
	Mean	SD	Mean	SD	Mean	SD
Linear Presentation	31.00	4.75	28.80	5.63	23.15	4.53
Two simultaneous Messages	21.10	4.80	20.05	2.31	16.00	4.20
Four Simultaneous Messages	15.00	3.64	14.35	3.28	14.20	3.61

*N = 20 for each experimental group

These results cannot be explained merely on the basis of reaching the "floor" of the test, because in all conditions performance was significantly above chance levels. Rather, they are due to the fact that while the linear and two voice presentations showed large significant ($P<.01$) losses in retention between the immediate and week delayed posttests (mean loss -7.85 points for linear and -5.10 points for two-voice), the four-voice presentation showed only a small non-significant loss (mean loss -.80 points). One possible explanation for this concerns the focus of the subjects of the material presented. Subjects in the linear presentation may have tried, as instructed, to listen to everything and to retain as much as possible. This would account for their initially high retention rate. Subjects in the two-voice conditions were faced with an information overload. Efficient processing required them to focus on certain aspects of the materials and/or presentation technique rather than trying to input everything. This strategy would account for their lower initial retention. However, the data organization involved in such an approach should provide a frame of reference which would aid recall. This would explain why the two-voice condition showed a lesser decrement in retention than the linear condition. The situation

would only be carried a step further in the four-voice condition, accounting for lower initial retention but little loss over time.

In short, the data supports the hypothesis that subjects use a focusing strategy when presented with large amounts of information. This limits original learning but enables the subject to retain the information learned more effectively, probably due to organizational factors in the processing of the data. In turn, it must be determined what makes certain aspects of the material more salient to the subject, thereby encouraging him to focus on them and learn them. Salience is a topic frequently considered in studies of perceptual processing. It may be induced through instruction, as in slective attention studies, or it may be a function of either the stimulus material or the presentation technique. In this study care was taken not to induce an attention focus in the instructions. Inspection of the data does not reveal any kind of consistent stimulus salience factor, nor does it show the presence of ear asymmetry or ear order recall, both of which have consistently occurred in prior research on dichotic presentations. Bartz et al (1967b) proposed that the ear asymmetry effect, which normally favors the right ear, provided salience for information presented to that ear. This would lead to selection of right ear

information for processing first (reflected in ear order recall) and produce better retention for the first processed information. However, in this study subjects gave no evidence of favoring either ear in dichotic presentations. This may indicate that ear order recall does not apply to connected discourse. It is possible that the whole procedure of information processing is different for connected discourse than for the stimulus materials such as nonsense syllables commonly used in studies of dichotic presentations.

No significant sex difference were found although women tended to perform better than men.

Conclusions

The results of the study indicated that learning does occur under conditions of multiple channel auditory presentation. While the amount learned decreased as the number of channels increased, materials learned under multi-channel conditions was very resistant to forgetting.

Without further investigation no claims can be made for the value of multiple channel presentation to the instructional process. At this time the primary area in which this method shows promise is the situation in which the individual wants a quick overview of a body of information, without needing to reach a criterion level of mastery. It would allow the subject to select out the information most relevant to his purpose, and attend to the remaining channels peripherally for additional material.

This study is one of the first to investigate use of connected discourse in multiple channel auditory presentations, and the results are encouraging. Future research should consider use of multiple channels with other sensory modes or in combinations of auditory channels and other modes.

It would also seem important to study individual differences in information processing to determine the reasons for wide variations among subjects. This approach may lead to an understanding of the different strategies used in dealing with perceptual input.

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