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SELECTIVE MEMORIZATION AS A FUNCTION OF INTENSITY OF VOICE PRESENTING ITEMS

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Two selective free recall experiments were carried out as a function of the intensity of a voice presenting the items, in order to examine the effects of the physical characteristics upon selective memorization. The percentage of correct recalls was greater and the number of intrusion-errors was smaller in the weak intensity condition than in the strong intensity condition in the rear section of serial positions. The effect of intensity was not clear in the initial and middle sections. The results suggest that the intensity affects the first selection which takes place before short-term memory, but not the second one which takes place in the process of transforming the to-be-memorized items into long-term memory, which reflects the difference in the ways how these selective processes work upon the items. It was also suggested that such effects were produced by the intensity of the item relative to that of the adjacent items.

Recent investigations of selective attention by means of the shadowing technique showed that the unattended message is not excluded at the early level of the information processing sequence, but receives the late level of complicated processing like a semantic analysis with the aid of long-term memory (Corteen & Wood, 1972; Lewis, 1970). These studies suggest a strong connection between the selective and memory processes.

Watanabe (1976, 1977) investigated the selective process in a memorization situation. Subjects were presented with 21 items binaurally at the rate of an item every 2 sec and required to memorize 8 items with the cue being given by a bell signal immediately before or after each item being presented. Subjects were required a free recall immediately after presentation. The percentage of correct recalls and the number of intrusion-errors, namely, the recall of the not-to-be-memorized items were examined after being divided into three sections of serial positions: initial, middle, and rear. On the basis of the results, the selective process in memorization was discussed in the divisions of the extraction and exclusion processes. The extraction of the to-be-memorized items takes place before short-term memory, but the exclusion of the not-to-be-memorized items does not. The latter takes place in the process of transforming the to-be-memorized items into long-term memory. It was also maintained that short-term and long-term memories are not strictly separated but closely connected.

Among the investigators of selective attention by means of the shadowing task, there is a position that attaches importance to the relation of the physical characteristics of the message (e.g. spatial location, intensity, and quality of the voice) to the

selective process, partly agreeing that long-term memory participates in the selective process. Treisman (1960) argues that an unattended message receives the process with the aid of long-term memory, but is attenuated on the basis of the results from the analysis of the physical characteristics of the message. Therefore, an unattended message cannot be perceived if it is not expected with high probability.

It is predicted that the physical characteristics of the presented item will also become one factor in the selective memorization task. The above-mentioned idea that the intensity of the attended message is intensified while that of the unattended message is attenuated, also coincides with our daily impression obtained when we attend to a portion of the environment. If selection is performed by changing the intensity level of the information, it is conversely expected that the selective process will be affected by the physical intensity with which the information is presented. Two experiments were carried out by means of a modified procedure of Watanabe's selective free recall experiments as a function of the intensity of the voice presenting items. If we understand the process of selective memorization as the extraction and exclusion processes after Watanabe (1976, 1977), the following can be predicted. The items of weak intensity will be easier to exclude and more difficult to extract than those of strong intensity.

Experiment I

The purpose of this experiment is to examine the effects of voice intensity upon selective memorization, where the items are presented using a voice which either has constant strong intensity throughout the list or constant weak intensity.

Method

Subjects: The subjects were 14 undergraduates (6 males and 8 females) from Kyushu University.

Apparatus and stimulus materials: Two practice and six main lists of 21 words were prepared for the memory task, in addition to a list of 16 words each for the hearing and dictation tasks. The words were Japanese two-syllable words of non-association values between 0 and 9 chosen from the list presented by Umemoto, Morikawa, and Ibuki (1955). Each word in the list had neither a semantic nor acoustic relation with the adjacent words.

The words were recorded by a male speaker at the rate of one every 2 sec with an interval of 3 sec after the starting signal on one track of the tape. A bell signal was recorded immediately before each word in eight out of the 12 serial positions (2, 4, 5, 7, 9, 10, 12, 14, 15, 17, 19, 20), every trial on the other track of the tape for the memory task. The word following a bell signal was a to-be-memorized item. The signal indicated each word in the 12 serial positions as a to-be-memorized item twice throughout a block of three main lists. A bell signal was recorded immediately before six words for the hearing and dictation tasks.

Procedure: The subjects had a hearing, dictation, and memory tasks in sequence. The subjects were asked to listen to a list of 16 items presented binaurally using a voice of weak intensity in the hearing task and then to write down six words following a bell signal in the dictation task. These tasks ascertained that subjects were capable of catching the words of this voice intensity. This intensity was equal to that of the weak intensity condition in the memory task.

The subjects were given instruction to memorize the words following a bell signal out of the words presented through the loudspeaker (a distance of 1.2 m from the subjects) and write down these words in any order for a minute following an ending signal. Then they were given a memory task of two blocks of a practice and three main lists, one block each under the weak intensity and strong intensity conditions with a minute rest between the blocks. The order of the conditions was counterbalanced

across subjects. At last, the subjects were required to have another dictation task for the to-be-memorized items using the same lists and by the same method as the memory task. Each subject was tested individually in the soundproof room.

Control over the output level at the time of playing back the recordings, produced two kinds of intensity conditions. The intensities of items under weak and strong intensity conditions were approximately 47 and 66 dB SPL, respectively at the positions where the subjects were seated. The corresponding intensities of a bell signal under each condition were approximately 44 and 62 dB SPL, respectively.

Some days after the experimental session, two of the subjects were asked to classify the list items used in the memory task which were presented randomly in either intensity condition, into two categories of intensity, weak or strong. All the items were classified correctly.

Results

The recalled items were scored correct if they coincided with the to-be-memorized items in the list prepared originally or the items written down by the same subject in the second dictation task. The second experiment also followed the same scoring standard. The total number of correct recalls in each of the 12 serial positions through the three main lists were divided into three sections of serial positions: initial (2, 4, 5, 7), middle (9, 10, 12, 14), and rear (15, 17, 19, 20). The total number of intrusion-errors in each of the 21 serial positions through the main lists were divided into three sections of serial positions: initial (1–7), middle (8–14), and rear (15–21). The data for each subject form the basic data used below.

Figure 1 shows the percentage of correct recall and the number of intrusion-errors averaged for the subjects in three sections of serial positions as a function of the voice intensity. As is shown in the figure, no difference in either index was found between these two conditions.

A three-way analysis of variance (intensity, section of serial positions, and subject) was carried out on the number of correct recalls. The main factor of the

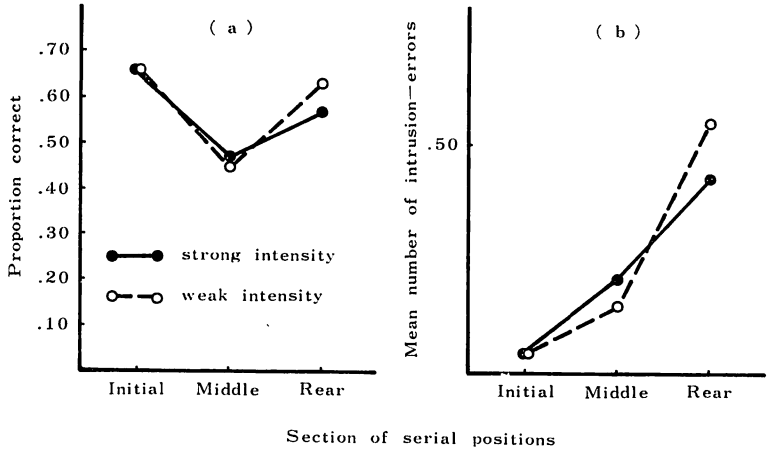

Fig. 1. The percentage of correct recall (a) and mean number of intrusion-errors through 3 trials (b) under two intensity conditions as a function of section of serial positions (Experiment I).

section of serial positions was significant ($F_{2,26}=6.73$, $p<.01$), but neither the main factor of intensity ($F_{1,13}=.29$) nor their interaction ($F_{2,26}=.37$) was significant. The same analysis of variance was carried out on the number of intrusion-errors ($\sqrt{X}+\sqrt{X+1}$ transformed scores for each subject). Neither the main factors of intensity ($F_{1,13}=.06$) and the section of serial positions ($F_{2,26}=2.41$) nor their interaction ($F_{2,26}=.59$) were significant.

Experiment II

The purpose of this experiment is to examine the effect of voice intensity upon selective memorization, where some half of the items forming the list are presented with a voice of strong intensity and the rest with a voice of weak intensity.

Method

Subjects: The subjects were 18 undergraduates (7 males and 11 females) from Kyushu University.
Apparatus and stimulus materials: The lists were the same eight lists for the memory task and two lists for the hearing and dictation tasks as in the first experiment. The original tape was produced by recording a list of items in the same way as in the first experiment using a tape recorder.

Controlling the output level of the tape recorder with every item of the original tape played back, the list of items was rerecorded on one track of the tape by means of another tape recorder, in order to produce two kinds of intensity conditions for the list. Four of the to-be-memorized and six or seven of the not-to-be-memorized items in each list were recorded using strong intensity and the rest were recorded using weak intensity. Therefore, exactly half of the total items through the six main lists were recorded using strong intensity and the rest were recorded using weak intensity. Special care was taken that items of strong and weak intensity should appear impartially in the list. Two series of lists were prepared so that the intensity of each item in the lists might be different between the series. Finally, bell signals were recorded on the other track of the tape in the same way as in the first experiment.

The intensity of item under weak and strong intensity conditions were the same as in the first experiment. The intensity of a bell signal was the same as that in the strong intensity condition in the first experiment. According to the classification task similar to that in the first experiment, 98.4% of all the items were classified correctly into the two categories by two of the subjects.
Procedure: Before the memory task the subjects were given instruction which was the same as in the first experiment except for stress on that the distinction between the to-be-memorized and not-to-be-memorized items did not correspond at all to the difference between the two voice intensities. A block of two practice and six main trials were required of half the subjects for one series of the lists and the rest for the other series.

The experimental procedure was the same as in the first experiment except for the above-mentioned conditions.

Results

The total number of correct recalls in each of the 12 serial positions and that of intrusion-errors in each of the 21 serial positions through the six main lists were divided into three sections of serial positions in the same way as in the first experiment. The data for each subject form the basic data used below. As is shown in Fig. 2, the difference between the two intensity conditions in each of the indices varies with the section of serial positions.

A three-way analysis of variance (intensity, section of serial positions, and subject) was carried out on the number of correct recalls. The main factor of the

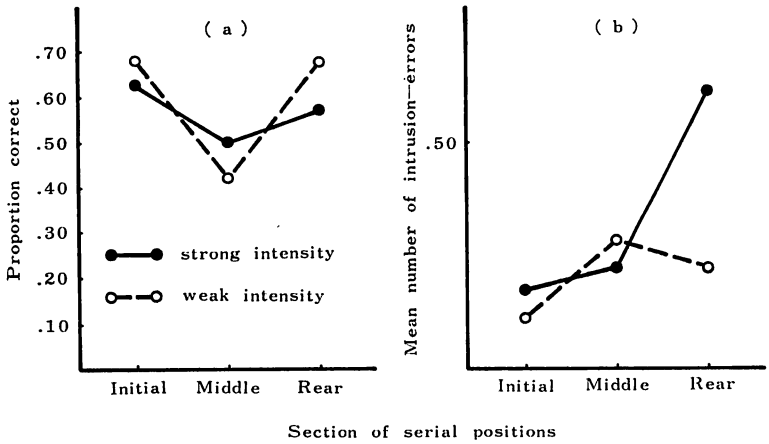

Fig. 2. The percentage of correct recall (a) and mean number of intrusion-errors through 6 trials (b) under two intensity conditions as a function of section of serial positions (Experiment II).

section of serial positions ($F_{2,34}=17.40$, $p<.001$) and interaction of that with the intensity ($F_{2,34}=4.74$, $p<.05$) were significant, but the main factor of the intensity was not significant ($F_{1,17}=.65$). The t-test conducted in each section of serial positions found that the number of correct recalls in the weak intensity condition was significantly greater in the rear section (t (17)$=2.29$, $p<.05$), and tended to be significantly smaller in the middle section (t (17)$=1.80$, $.05<p<.10$) than each in the strong intensity condition.

The same analysis of variance was carried out on the number of intrusion-errors ($\sqrt{X}+\sqrt{X+1}$ transformed scores for each subject). The interaction of the main factors of the intensity and the section of serial positions only approached significance ($F_{2,34}=2.85$, $.05<p<.10$; one-tailed test). The t-test conducted in each section found that the number of intrusion-errors in the weak intensity condition was significantly smaller than that in the strong intensity condition only in the rear section (t (17)$=2.25$, $p<.05$).

Discussion

In the first experiment, no difference was found between the intensity conditions in either index of the percentage of correct recalls and the number of intrusion-errors. The results were interpreted as follows. When items are presented with a constant voice intensity throughout the list, the subjects are able to be adapted to the intensity level under conditions, and thereafter, the subjects process the items in the same way irrespective of their voice intensity level so long as they can be heard clearly.

In the second experiment, a difference was found between the intensity conditions in both indices depending upon the section of serial positions. The results were as follows, regarding the correct recalls as representative of success in extraction of the to-be-memorized items, and intrusion-errors, failure in exclusion of the not-to-

be-memorized items. In the rear section of serial positions, the items of weak intensity were easier not only to exclude but also to extract than those of strong intensity, which disagrees with the previous prediction. It seems as if the subjects adjusted themselves in favor of selecting the items of weak intensity. In the initial section, there were not any of the above-mentioned effects in the extraction. In the middle section, conversely, the items of strong intensity even tended to be easier to extract than those of weak intensity. There were not any differences in the exclusions between the intensity conditions in either of these two sections.

In the situation of memorization using free recall, it is assumed that the subjects are transforming the presented items from sensory memory into long-term memory by way of short-term memory successively in the memory system. The U-shaped free recall curve obtained immediately after the item presentation shows the positions of the items in the memory system at the time of recall. Recalls in the rear section of serial positions represent those of the items in short-term memory, and recalls in the initial and middle sections represent those of the items which have been transformed into long-term memory at the time (Atkinson & Shiffrin, 1971; Glanzer & Cunitz, 1966; Murdock, 1967).

Especially, the following is considered in the present experimental situation. Recalls in the rear section represent the results from the first selection which takes place before short-term memory, while recalls in the initial and middle sections represent the results from the second selection which takes place in the process of transforming the to-be-memorized items from short-term memory into long-term memory (Watanabe, 1976).

Therefore, the above-mentioned results indicate that the intensity of an item can be an important factor for selective memorization, but its effects are confined to the first selection. This is probably because the first selection includes sensory memory in the process, while the second selection works upon the categorized items which have been transformed into short-term memory. However, it is not clear how the intensity of the items affects such a selective process in detail.

At last, such effects of intensity were not found in the first experiment in which the items were presented using a voice with either constant strong intensity throughout the list or constant weak intensity, but in the second experiment, in which the items were presented using a voice of different intensity for the list. These facts suggest that selective memorization is not affected by the absolute intensity of the item but the intensity relative to that of the adjacent items.

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