Imitative modeling of voice intensity¹

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Behavioral modeling of voice intensity was demonstrated under several conditions. Four groups of Ss first read a list of words aloud, then listened to a list of words, and finally read a third list of words aloud. The sound intensity of the second list was high (115 dB) for two groups and low (20 dB) for two groups. Within an intensity level, one group wore earplugs during the reading of the third list, while the other group did not. Ss who heard the words at a high intensity increased the intensity of their voices more than Ss who heard the words at a low intensity.

It has been established that Ss will imitate the motor response of others, even under conditions where it is difficult to define the reinforcement, e.g., social approval by peers, recognition by persons of high status, or the reduction of frustration (Bandura & Walters, 1963). Most laboratory demonstrations of imitation have involved unusual stimulus conditions such as are found in the modeling of aggression or other extreme emotions (Bandura & Walters, 1963). Apparently, stressful situations are particularly suited to show modeling effects.

Walters, Marshall, & Shooter (1960) have shown that a stressful situation also leads to better modeling of perceptual responses, for example, judgments of the autokinetic effect. With the exception of this study and an unpublished experiment by Walters, Bowen & Parke (Bandura & Walters, 1963), very little seems to be known about the imitation of simple perceptual or sensory phenomena. This situation exists despite the possible significance of such work for a theory of perceptual learning, including the learning of language behavior (Mowrer, 1960). The modeling of perceptual effects is also interesting from the viewpoint of learning theory, since the demonstration of modeling here may not obviously relate to reinforcement factors such as social reward, status of a confederate, etc.

The present report concerns an investigation of modeling effects in a simple perceptual situation, one involving the modeling of the intensity of the spoken word under conditions designed to minimize the influence of S anxiety, as well as explicit and/or implicit sources of social reinforcement. In addition, because of the possible role of sensory feedback in the learning and subsequent reproduction of imitative responses (Mowrer, 1960), an attempt was made to study this factor

directly. Toward this end, normal feedback from the voice was distorted during tests of modeling effects for half the Ss, and not for the other half.

SUBJECTS

The participants in this experiment were 31 men and 9 women, between the ages of 18 and 26, enrolled as summer students at the University of Pennsylvania. All Ss stated they had normal hearing, and all were naive concerning the purpose of the experiment.

APPARATUS

The experiment was conducted in two adjoining rooms; S was in one room, E was in the other. The S's room was soundproof and was connected to E's room by an opening in one of the walls. The S sat at a table with his chin and head reasonably fixed by appropriate rests. He wore earphones during part of the experiment (Koss Model SP-3 stereophones) and a pair of Fittsrite Audophone earplugs was provided for Ss in two of the experimental conditions. An Electro-Voice Model 664 microphone was located on the table, 9 in. from S's mouth.

The E's room contained a Viking 95 Transport and a Wollensak T-1500 recorder. The tape transport was connected to the earphones, and hence, sound stimuli could be presented directly to S. The Wollensak was connected with the microphone, and

was used to record verbal responses. All measures of sound intensity were made with a General Radio sound-level meter, operated together with an impact-noise analyzer for measurement of peak-response intensity.

WORD LISTS

Three lists of English words were used. Each list consisted of one-syllable words which were randomly selected from the phonetically balanced tests reported by Hirsh (1952). The words were simple and easy to pronounce, e.g., box, ride, pat, tan.

List 1, used in Phase 1 of the study, consisted of 30 words, printed in a single column on a piece of paper. List 2, consisting of 180 words, was used in Phase 2 of the study and was prerecorded on tape by one of the authors (M.T.). Presentation of List 2 required 3 min. The final list (3) consisted of 60 words printed in two equal columns on a piece of paper.

PROCEDURE

The experiment consisted of three major phases. The S was instructed on the nature of these three phases before the experiment began. Once in progress, the experiment was shifted from one phase to another through printed instructions. The 40 Ss were randomly divided into four groups (A, B, C, D), with 10 Ss in each group.

In Phase 1 S read aloud from List 1, and his voice was recorded. He was simply asked to read the list into the microphone. In Phase 2 S listened to List 2 through the earphones. The average peak intensity of the sound (words) for Ss in Groups A and B was

Fig. 1. Mean intensity difference between words spoken in Phase 1 and Phase 3 as a function of word position (order spoken) in Phase 3. Each data point is based upon 10 median intensities measured on the voices of 10 Ss. The high-intensity group heard words spoken at an average intensity of 115 dB during Phase 2, whereas the low-intensity group heard the same words at an intensity of 20 dB. For more details, see text.

Fig. 2. Mean intensity difference between words spoken in Phase 1 and Phase 3 as a function of word position in Phase 3. Each data point is based upon 10 median intensities. Ss in both the high- and low-intensity conditions wore earplugs during Phase 3. For more details, see Fig. 1 and text.

115 dB, whereas, the average intensity for Groups C and D was 20 dB. In Phase 3 S read List 3 and these responses were recorded. Groups A and C wore earplugs during the third phase of the experiment, whereas, Groups B and D did not. After Phase 3 was completed, a brief interview was conducted in which Ss were asked about their understanding of the purpose of the experiment.

RESULTS

The dependent variable of interest was the change in voice intensity after listening to the experimental words of List 2. For each S, peak voice intensity was measured for spoken words in Lists 1 and 3. Three measures of each word were made by means of the sound-level meter together with the impact-noise analyzer. The median measure of intensity was used in subsequent analyses. The intensity difference in decibels was calculated between words in comparable positions from Lists 1 and 3, for each S. That is, the intensity obtained for the first word spoken in List 1 was subtracted from the intensity of the first spoken word in List 3, etc. Since there were twice as many words in List 3 as in List 1, a variation on this procedure was necessary for the last 30 words in List 3. For these words, the matching procedure was begun over, with Word 31 from List 3 paired with Word 1 from List 1, etc.

Data trends are presented in Figs. 1 and 2. In Fig. 1 the mean intensity difference between alternate words in Lists 1 and 3 is given as a function of word position. The

upper solid lines connect the means calculated for the 10 Ss who did not use earplugs and were under the high-intensity conditions. The lower dashed lines connect the means for the comparable group under low intensity. The solid horizontal line through zero represents no change in voice intensity from List 1 to List 3. Figure 1 also highlights the reliability of the measurement procedure. Fluctuations in the data points appear to be mainly due to differences in the phonetic characteristics of individual words. This is likely since the fluctuations are almost identical for both groups even though measurements were made independently on different Ss, but for the same words. Figure 2 presents comparable data for the earplug groups.

For purposes of statistical analysis, alternate words were chosen from the lists since preliminary analysis indicated that this selection did not bias the results. An analysis of variance was conducted on the intensity differences between Lists 1 and 3 along the lines suggested by Lindquist (1953) for a Type III design. This analysis indicated that stimulus intensity was a significant source of variance [$F(1,36) = 9.71, p < .05$], as was word position [$F(14,504) = 4.35, p < .05$]. However, there was no significant difference between the means of the earplug and the no-earplug groups, and none of the interactions were significant. The change in voice intensity was in the direction one might predict on the basis of a modeling theory. Those Ss who heard List 2 at a high intensity increased the intensity of their

own voices more than Ss who heard List 2 at a low intensity. Moreover, there was no clear indication that changes in voice intensity subsided, even toward the end of List 3. What is most clear is the difference between high- and low-intensity groups throughout most of the range of word positions.

The informal interviews held after the experiment suggested that none of the Ss guessed the purpose of the experiment, and only a few stated without prompting that the voice intensity in Phase 2 was abnormally loud or soft!

DISCUSSION

The modeling of voice intensity is clearly shown by the results in Figs. 1 and 2. Modeling of the low-intensity voice was more apparent for the group with earplugs than for the group without earplugs, but the relevant interaction term was not statistically significant. Modeling was by no means faithful to the modeled stimulus in any of the groups. Most of the changes in voice intensity were on the order of two or three decibels, whereas, there was almost a 100-dB difference between the intensities of the loud and soft models. Nonetheless, the small difference in voice intensities between the high- and low-intensity groups was consistent, as shown by the complete trends in Figs. 1 and 2.

Modeling of voice intensity was comparatively easy to obtain in this study. No obvious social rewards were attached to the modeling behavior, although, of course, one can always postulate that subtle rewards of this nature did exist (cf. Bandura & Walters, 1963; Rosenthal, 1966). An effort was made not to arouse anxiety in Ss and attempts also were made to eliminate the role of E as a source of social reward. Informal interviews after the experiment suggested that these precautions were successful, since Ss stated they were neither aware of the purpose of the experiment nor of their modeling behavior.

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NOTE

1. This experiment was conducted at Associates for Research in Behavior, 1 Paoli Place, Philadelphia, Pa. During the study the authors also were associated with Princeton University. We thank Dr. Rogers Elliott for his comments on the paper.