Direct scaling of vibrotaction: An individual replication*

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A single S was retested after an intervening period of 3 years using the method of numerical magnitude balance. The stimulus parameters were nearly identical in both experiments. The slope of the subjective magnitude function was the same at higher intensities. Near threshold, the curve was steeper, corresponding to results seen in the data of the two groups in which the individual served as a S.

Experiments on the subjective magnitude functions for vibrotaction provided an opportunity to retest the same S under the same experimental conditions after an intervening period of 3 years. The S had had no testing during the period between the two experiments and was naive with respect to the underlying rationale of the method. The two sets of data provide a test of the stability of results obtained by the direct scaling methods of Stevens (1955, 1956).

*This study was supported by Grant GB-8412 from the National Science Foundation and Grant NINDB-NB-03950-08 from the National Institutes of Health, U.S. Department of Health, Education and Welfare.

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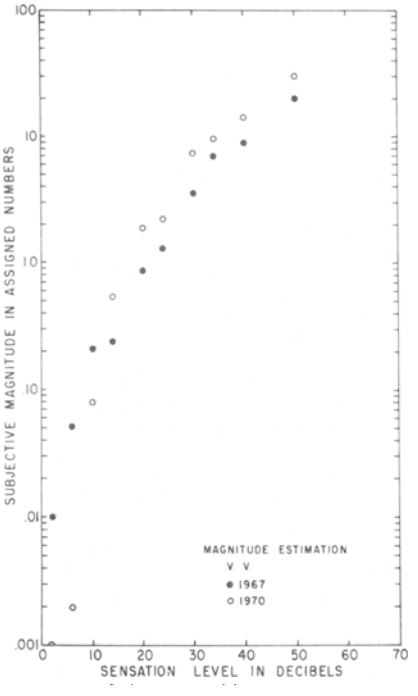

Fig. 1. Numerical magnitude estimation of subjective vibration intensity as a function of sensation level. Symbols represent the raw data of a single S measured in 1967 (●) and in 1970 (○).

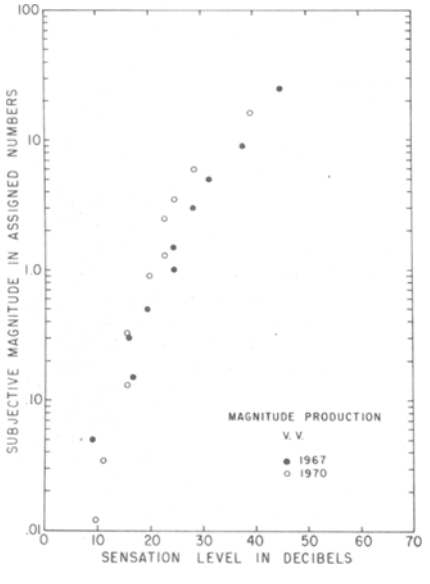

Fig. 2. Subjective magnitude production for assigned numbers. Symbols represent the raw data obtained from a single S in 1967 (●) and in 1970 (○).

APPARATUS AND PROCEDURE

The apparatus and method used in the experiments are described in detail elsewhere (Verrillo, Fraioli, & Smith, 1969). Briefly, 250-Hz bursts of sinusoids lasting 1 sec with a 1-sec silent period were delivered to the thenar eminence of the right hand. A 2.9-cm² contactor protruded through a hole in a rigid surface, which supported the entire forearm of the S. The gap between the moving contactor and the rigid surround was 1 mm. Measurements of displacement were made by a carefully calibrated accelerometer mounted on the moving coil of the vibrator.

The method of psychological magnitude balance (Hellman & Zwislocki, 1963) was used, which is the nonnormalized combination of methods of magnitude estimation and magnitude production (Stevens, 1955, 1958). The S first assigned numbers to a random series of 10 intensities above threshold (magnitude estimation). No reference standard was used. The data were plotted in terms of assigned numbers as a function of sensation level. The psychological magnitude of vibration was then matched, by means of an attenuator controlled by the S, to numbers presented in random order by the E (magnitude production). Averaging (geometric mean) the magnitude estimation and magnitude production curves produced the magnitude balance function.

RESULTS

The raw data obtained by magnitude estimation for both experiments are shown in Fig. 1. The raw data obtained by magnitude production are shown in Fig. 2. These figures reveal a remarkably close correspondence of points for the old and new sets of data. Figure 3 shows the magnitude balance functions derived from the data points presented in Figs. 1 and 2. Curves have been drawn through the data points in order to determine the slopes of the curves. When computed in terms of energy, the value of the slopes in the upper portion of the curves is 0.445 for both sets of data.

Near threshold there was a pronounced steepening of the curve in the new data compared to the data obtained in the earlier experiment. It

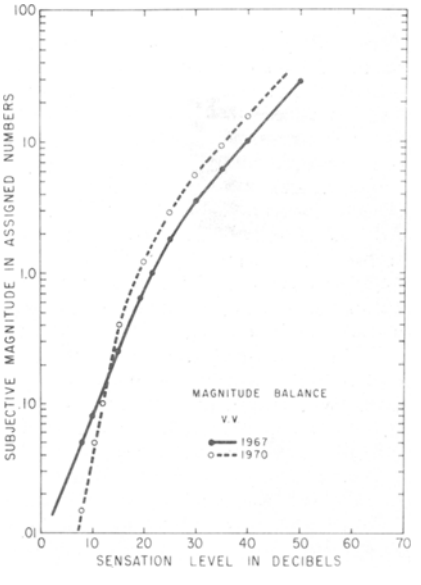

Fig. 3. Numerical magnitude balance curves drawn through data points derived from Figs. 1 and 2. The slope for the portions of the curves above approximately 20 dB SL is .445 for both curves.

is possible that this change was brought about by an improvement that was made in the stability of the platform which held the S's forearm. Such an improvement would have a greater effect at intensity levels near the threshold. A similar change in the steepness at near-threshold intensities was seen in the grouped data comparing all Ss from the two experiments (a total of 15 Ss).

The results are accepted as evidence that the psychological mechanism by which people are able to make intensity judgments remains relatively stable, at least for the period of time (3 years) used in this experiment. The data may also be accepted as evidence of the reproducibility of results using direct scaling procedures for vibrotaction.

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The variety effect in free recall as a function of prerecall activity*

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The enhancement of free recall of object categories represented by varied, as opposed to repeated, specimens was studied when Ss recalled immediately after presentation of the stimuli vs when they worked arithmetic problems for 1 min before recalling. All Ss recalled three times, the second and third recalls in all cases being preceded by 1 min of arithmetic. Results indicated no change in recall over the three trials. However, the varied categories were recalled better than the repeated categories, and the difference was reduced when interpolated activity was required. The interpolated activity was more effective for the female Ss and appeared to depend upon the particular categories that were varied or repeated. The findings were interpreted as indicating the contribution of retrieval processes to the variety effect.

Several recent experiments have reported that free recall of categories of objects is better when the categories are represented by several different specimens than when they are represented by the same specimen repeated an equivalent number of times (Bevan, Dukes, & Avant, 1966; Daves & Adkins, 1969). This effect has been termed the variety effect (VE) and has been observed in children as well as in college students (McCarson & Daves, in press). In one study, Daves & Rinn (1971) compared the recall of varied and repeated categories in Ss receiving one, two, three, or four exposures to the category. Repetition was found to inhibit recall up to three exposures, while variation produced an increase in recall over the first three exposures. After 2 weeks, recall was essentially the same for the varied and repeated categories. Since category variation was manipulated with Ss, it was suggested that the effect might be due to the establishment of priorities in a limited-capacity retrieval system.

The present experiment was conducted to obtain further information on the "localization" of the phenomenon, i.e., whether or not it is related to output processes. Since all of the experiments reporting the effect thus far have had Ss recall immediately after presentation of the stimuli, the question arises as to whether or not the effect is predominantly related to short-term memory, or if it also occurs with longer retention intervals. Although delayed recall has been employed in studies of the VE (e.g., Bevan et al, 1966; Daves & Rinn, 1970), these studies employed an immediate recall for all Ss as well, which introduces the factor of immediate rehearsal. Consequently, in the present study an arithmetic task was interpolated between exposure and recall for half of the Ss, the expectation being that, if the VE were related to short-term retrieval organization, the difference in recall between varied and repeated categories would be reduced when the interpolated activity was required.

*This research was partly supported by funds from the National Science Foundation, Grant No. GU 2751, to Georgia State University. Requests for reprints should be directed to Dr. Walter F. Daves, Department of Psychology, Georgia State University, 33 Gilmer Street, S.E., Atlanta, Georgia 30303.

SUBJECTS AND DESIGN

The Ss were 24 male and 24 female volunteers from introductory psychology classes, who served in the experiment as part of the course requirement. They were tested in groups varying in size from one to six. Half of the Ss were assigned to Group IA-M, which received 1 min of interpolated activity (working arithmetic problems) before recall, and the other half recalled immediately (Group IA-NM). Within the above subdivision, half of the Ss in each group received Category Arrangement A (CA-A) and half received CA-B (see below). All Ss received three recall trials (RT) and two levels of variety (VL). For each S half of the categories were represented by four identical specimens (R categories), and half were represented by four different specimens (V categories). Thus, there were three between-S variables: sex, IA, and CA; and there were two within-S variables: RT and VL.

STIMULUS MATERIALS

Stimuli consisted of 72 color slides representing 18 categories of common objects. All objects were photographed against a common off-white background. Each of the categories was represented by four different specimens (e.g., for the category "watches," there were four different watches), and there were four identical photographs of each specimen. Thus, each category could be represented by one of the four specimens repeated four times or by four different specimens. Two sets of 72 slides were selected. For the slides in Category Arrangement A, the R categories consisted of ash trays, books, cereal boxes, chairs, keys, lamps, pens, rings, and shoes; and the V categories were watches, typewriters, flowers, knives, candles, pillows, bottles, balls, and purses. For the slides in Arrangement B the arrangement was reversed. Thus, for example, Ss in Group CA-A viewed four different watches and the same ash tray repeated four times; Ss in Group CA-B viewed the same watch repeated four times and four different ash trays. In total, each S viewed each category four times, once in each block of 18 trials. Within blocks the categories were arranged haphazardly.

The slides were presented with a Kodak Carousel projector whose internal shutter had been modified with a solenoid latch to permit control of exposure duration. Exposure duration was 0.5 sec, and the interval between onsets of successive slides was 2 sec. These intervals were controlled by a Hunter Model 1514 timer and monitored periodically with a Tektronix Model 503 oscilloscope