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"NOISE AND LOUDNESS EVALUATION".

SOME FURTHER PROCEDURAL FACTORS INFLUENCING THE SLOPE OF THE LOUDNESS FUNCTION

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Some further procedural factors influencing the slope of the loudness function

Many studies involving a wide range of prothetic sensory continua appear to support S.S.Stevens' contention that direct estimates of sensory magnitude grow as power functions of stimulus intensity. Each continuum apparently yields a characteristic exponent ranging from about 0.3 for brightness to 3.5 for judgements of the subjective intensity of electric shock. One interpretation of the power law exponent is that it provides important information about the transducing properties of the sensory mode in question. But an alternative view, expressed most forcibly by Poulton (1967) is that "the sizes of exponents are merely a function of the experimental conditions under which they were determined (p. 316)."

Several procedural factors have been shown to influence the value of the obtained exponent. These include the range of physical stimuli used, the position of the standard within the range, whether the range embraces the threshold region, the order in which the stimuli are presented, whether the numbers used by the observer are finite, infinite or a mixture of both, and the numerical value given to the modulus or standard. Among these, the range of stimuli employed exerts the single most powerful influence. Taking 21 sensory dimensions studied by Stevens and his associates, Poulton (1967) obtained a significant negative correlation between the size of the obtained exponent and the geometric stimulus range (tau = -.60; $\rho < .001$). But Teghtsoonian (1971) claimed that Poulton had underestimated the closeness of this relationship. Using logarithmic rather than geometric range, he obtained a Pearson r of -.94, indicating that over 87% of the variance in the reported exponents can be accounted for by variations in stimulus range.

To date, these 'procedural-artifact' critics have focussed upon the observer response biases indirectly and often unwittingly introduced by the experimenter in his selection of values for physical stimuli, particularly their range. In the present investigation, physical values were kept constant but a direct attempt was made to alter the calibration of the observers by manipulating the range of the corresponding subjective magnitudes. Incidental observations made while previously administering the technique of magnitude estimation (Reason, 1972) had suggested that powerful and predictable effects could be achieved through relatively slight changes in the preliminary instructions to the observer.

The procedure for both studies was identical. All the subjects were asked to give numerical magnitude estimates of the loudness of a

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1000 Hz tone (presented binaurally through earphones) at six sound pressure levels: 50, 60, 70, 80, 90 and 100 dB relative to 0.2 N/m^2. The tone was generated by a 'Maico' clinical audiometer. A modulus of 50 dB, equivalent to 10 units of subjective magnitude, was presented for comparison with the variable stimulus on each trial. Both the standard and variable stimuli were presented for approx. 1-2 seconds. The order of presentation of the variable stimuli was randomised, and a different order used for each observer.

In the first experiment, 24 male observers were randomly assigned to 3 conditions of instruction: 'weak','medium' and 'strong'. The nature of the instructions was similar to that quoted by Stevens (1956) and was the same for all groups except in one respect: the value of the numerical example cited at the end. In the case of the 'weak instruction' group, the key sentence was "For example, if it sounds twice as loud you will assign it a value of 20, and so on." For the medium instruction group it was ".....if it sounds ten times as loud, you will assign it a value of 100....", and in the strong instruction group, ".....if it sounds twenty times as loud, you will assign it a value of 200...." No other numerical examples were given.

The findings of the first experiment are summarised in Table 1. It is evident from these data that the instructional variations exerted a highly significant influence on the slope of the loudness function, but did not destroy the power relationship. The group geometric mean estimate at the 100 dB level was approx. 10 times greater under 'strong' instructions than under 'weak'. Furthermore, no overlap existed between the groups in the individual estimates made at this sound pressure level. The range of estimates for each group at 100 dB were - 'strong' (175 - 500), 'medium' (50 - 145), 'weak' (25 - 42.5). In view of these very marked instruction effects, the experiment was repeated using a different sample of 18 observers and a different experimenter (to avoid obvious experimenter-bias). As can be seen from Table 2, the results of this second study closely replicated those of the first, confirming the existence of a pronounced instruction effect in the technique of magnitude estimation. These findings were taken as providing further support for the 'procedural-artifact' point of view.

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Table 1. Group geometric mean data from the first experiment

Sound pressure level (dB)	Loudness estimates		
	Weak group (N = 8)	Medium group (N = 8)	Strong group (N = 8)
50	10.85	10.04	11.79
60	12.76	14.47	20.70
70	14.55	20.89	49.21
80	20.25	36.32	99.15
90	23.85	55.34	189.50
100	31.21	83.10	332.40

Table 2. Group geometric mean data from the second experiment

Sound pressure level (dB)	Loudness estimates		
	Weak group (N = 6)	Medium group (N = 6)	Strong group (N = 6)
50	10.60	10.25	11.30
60	13.58	14.50	16.50
70	17.76	20.83	40.00
80	24.58	29.33	80.00
90	31.16	48.41	184.16
100	39.16	76.75	295.83

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