Bulletin of the Psychonomic Society
1976, Vol. 7 (5), 478

A limit to intensity perception

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R. Teghtsoonian (1971) argued that psychological dynamic range and subjective resolving power are constant for all perceptual intensity scales. It follows that there is an upper limit to the number of sensations humans can process on all scales, and a formula is developed.

R. Teghtsoonian (1971) presented evidence of two basic regularities in intensity perception related to Stevens' psychophysical law. First, he argued that dynamic range of sensation is constant for all perceptual scales, so that for any scale

$$\log (\text{maximum sensation/threshold sensation}) = K \quad (1)$$

where threshold and maximum sensation are defined by the limits of the human body (this regularity results from an inverse relationship between scale exponent and log *physical* dynamic range). Second, Teghtsoonian argued that there is a constant subjective resolving power C so that a jnd occurs with a percentage change C in sensation, regardless of the stimulus scale involved. Both regularities are consistent with the idea of a central processing unit for all intensity judgments, and preliminary evidence suggests that the resolving constant C is approximately .030 and that the dynamic range constant K lies between 1.5 and 3.0 log units.

A direct development of Teghtsoonian's work is a formula to describe the maximum number of discriminable sensations which can be processed through the central unit. If threshold sensation has a defined value of 1.0, then under Teghtsoonian's principles, the next discriminable sensation (Sensation_2) would occur at $(1 + C)$. The third sensation (Sensation_3) would occur at $(1 + C) \cdot (\text{Sensation}_2) = (1 + C)^2$, and hence

$$\text{Sensation}_n = (1 + C)^{n-1} \quad (2)$$

where Equation 2 will be recognized as the compound interest formula applied to sensation. An early version of Equation 2 is reported by William James (1968) in the 1890 *Principles* (Vol. I, p. 586). To find the maximum number of sensations possible, Equation 2 can be solved for n and applied to the case of the maximum sensation:

$$n_{maximum} = \frac{\log (\text{maximum sensation})}{\log (1 + C)} + 1 \quad (3)$$

or

$$n_{maximum} = \frac{K}{\log (1 + C)} + 1 \quad (4)$$

where threshold sensation equals 1.0. The estimates reported by Teghtsoonian would place the value of $n_{maximum}$ between 118 and 235. A more precise prediction is made possible by an estimate of $K = 2.24$ reported in a recent experiment on finger span (Brenner, Note 1; mean, 38 subjects), one of the only perceptual scales in which the maximum sensation can be directly observed, and that estimate would put $n_{maximum}$ in the range of 175 sensations.

The value of $n_{maximum}$ defined by Equation 4 may be considerably larger than the limit of the central processing unit since some form of cognitive focusing may be required to produce a resolving power C at the sensory level. Equation 4 represents a limit to the entire system, however, and suggests that *humans can process a maximum of about 175 sensations regardless of the sensory scale involved.* The equation's physiological basis, its relation to the magical number seven (Miller, 1956), and its biological value remain to be determined.

This paper was sponsored by Irwin Pollack who takes full editorial responsibility for its contents. It was written while visiting at the Harvard Laboratory for Psychophysics.

REFERENCE NOTE

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(Received for publication January 16, 1976.)