

The Effect of Incidental Factors on Threshold Measurements

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The determination of "limens" or "thresholds" as a measurement of the sensitivity of receptor organs is a corner stone of psychophysics and experimental psychology. This technique is also used to advantage as a diagnostic instrument in clinical work. Not until recent years, however, has much attention been given to the factors affecting the stability of thresholds.

That the vague point in sensory discrimination, termed the "limen", is unstable is not surprising when one considers that its accurate determination depends upon the observer's ability to maintain a constant criterion of sensation throughout the experiment. Even if the observer could meet this requirement, changing conditions in the laboratory and subjective changes in the observer still significantly alter a threshold measurement. Goodfellow¹ has studied some of these factors affecting vibro-tactile thresholds, and he found that thresholds were changed by the following actors: 1. suggestion; 2. psycho-physical technique; 3. motivation; 4. practice or training; 5. the experimenter; 6. instructions to the observers; 7. part of the body stimulated; 8. fatigue of the end-organ due to previous stimulation; 9. long period of sleep immediately before measurement; 10. intense illumination. Ray Mars Simpson² enumerates over forty factors involved in measuring sensory thresholds, including such factors as "mental set", "aufgabe", anticipation, motivation, suggestion effects through the experiment criterion of judgment, instructions, and attention.

For some time we suspected that observers, when forced to make discriminations at or slightly below their threshold, did not rely entirely upon the modality being measured but turned to incidental variables in an attempt to gain cues from the environment. To test this possibility, we introduced a known cue into an ostensibly normal set-up for determining thresholds. Our primary concern was the selection of a cue that could be controlled and at the same time was in and of itself least affected by the factors mentioned above. We finally employed time discrimination in the visual "ready" signal because it most nearly approached our criteria for an unaffected cue.

Observers were requested to place their fingers on a vibrator and determine at a given signal whether or not any stimulus was present. As a "ready" signal we used a flashlight bulb placed behind a two-inch square of red paper and situated directly in front of the observer. It was either one second or one and three tenths seconds in duration. The long (1.3 sec.) and short (1 sec.) "ready" signals were used in a random order. Both the "ready" signals and the two-second interval following each stimulus were accurately controlled by mechanical means.

During this particular experiment, the vibrator was completely disconnected from the power supply, in order that we might be absolutely sure that any extra-chance results were due to responses to our differential signal rather than to a subliminal vibratory stimulus. The observers were instructed that the vibrations would be below threshold but that by responding to "hunches" and by careful attention to the vibrating instrument they should be able to achieve better than chance results in determining whether

the vibrator was activated or not. After each appearance of the "ready" signal, the observer was expected to respond "yes" or "no".

During the first half of the experiment, judgments were taken in groups of five, to determine whether any allowance had to be made for a pattern effect similar to that found in the Zenith telepathy data.³ Each observer recorded his own response on the forms supplied by the experimenter. An analysis of several hundred responses from each of five observers show two pronounced tendencies,⁴ namely, a tendency to respond in the negative; and secondly, a tendency to follow certain patterns or sequences. Any tendency to use our extraneous cue was, if it existed, over-shadowed by these two other tendencies.

Consequently, the chief problem seemed to be the elimination or control of these two factors. To accomplish this we changed our instructions and procedure in certain details. First of all, we impressed upon the observers the fact that even though the stimuli were subliminal, they would, by responding to any slight impression or "hunch", be correct more often than not. Furthermore, we reminded our observers that stimuli were presented in chance order, and therefore, there would be approximately an equal number of "yesses" and "noes". These instructions we hoped would reduce the tendency to respond with a preponderance of "noes." By having the observers report their guesses directly to the experimenter over our loud-speaker telephone system, we hoped to minimize the tendency to follow particular patterns or sequences. (We assumed that this observed tendency to follow certain patterns or sequences is due largely to the influence of one's previous responses. By using an oral report, we removed the necessity of having our observer's previous responses called to his attention.) Six observers were used under this new set-up, and the results are shown in table one.

TABLE I

Table showing the number of positive responses on the long ready signal and negative responses on short ready signal.

| | Actual number of coincidences | Expected by chance | Deviation | Sigma | C.R.* |
|-------------|-------------------------------|--------------------|-----------|-------|-------|
| L.M.----- | 67 | 75 | -8 | 6.2 | -1.3 |
| A.M.----- | 108 | 100 | 8 | 7.1 | 1.1 |
| J.C.----- | 480 | 350 | 80 | 13.2 | 6.1 |
| L.W.----- | 111 | 100 | 11 | 7.1 | 1.6 |
| I.H.----- | 52 | 50 | 2 | 5.0 | .4 |
| C.O.----- | 134 | 100 | 34 | 7.1 | 4.8 |
| Totals----- | 902 | 775 | 127 | 19.7 | 6.4 |

* A critical ratio of three or more, indicates that the obtained deviation from expectation cannot reasonably be attributed to chance.

J. C., a male college student, was the first observer whose scores indicated that he was reacting to our cue. On his first series he showed a tendency to respond "yes" on the long (1.3 sec.) signal, and "no" on the short (1 sec.) signal. On the fourth series this tendency produced statistically significant results. His introspections showed that he had been unable to feel any vibration or even derive any "hunches" from the vibrating instrument so that he had concentrated more on the ready signals. On the succeeding series of tests, his introspections failed to mention the signal light again, but laid his success to the fact that he was "very relaxed, and in a receptive mood."

Of particular interest was the reaction of I. H. to one series in which, unobserved by us, the contacts on our timing mechanism had become roughened so that the signal light flickered rather than producing a steady glow. The long and the short signals had a distinctive flicker. Eighty-two percent of I. H.'s responses followed the formula:—long ready signal equals "yes",

short ready signal "no." Her introspections revealed this differential flicker between the two lights. We immediately adjusted the apparatus but not without being embarrassed to think that even an experiment on incidental factors affecting psycho-physical measurements was affected by an unpredicted incidental factor.

Another fact which is interesting and has a possible significance is that with the exception of L. M.'s results, every observer showed a tendency to respond "yes" on the long ready signal and "no" on the short one. It is not unreasonable to suppose that all of the observers were in the same degree influenced by our cue. This supposition has possible support when it is further observed that, although only two observers achieved extra-chance scores, the group as a whole was significantly above chance.

Fully aware that neither the number of observers employed nor the actual results obtained warrants a conclusive statement concerning the effect of cues on psycho-physical measurements, we wish only to say that this is an indication of what might happen in the determination of thresholds. When an observer is being tested for sensory acuity, he may either be like at least three of our observers and stolidly refuse to acknowledge the stimulus until it is unquestionably present—that is he sets his criterion of sensation far too high, or he may react to what is ordinarily an inadequate stimulus and base his response on some factor having no connection with the stimulus other than temporal agreement.

¹ Goodfellow, L. D., Factors Affecting Thresholds, (not yet published).

² Simpson, R. M., Effects of Muscular Tension on Visual and Tactile thresholds, doctoral thesis, Northwestern University, 1937.

³ Goodfellow, L. D., A Psychological Interpretation of the Zenith Radio Tests of Telepathy, *Journal of Experimental Psychology*, Dec., 1938, 23, 601-32.

⁴ Goodfellow, L. D., Heine, R. W., and Ranssen, Emil. The Significance for Psychometry of Tendencies to Follow Certain Patterns in Recording Judgments.