Determination of a DL using two-point tactual stimuli: A signal-detection approach

HENRY A. CROSS, WILLIAM N. BOYER, and GARY W. GUYOT*
Colorado State University, Fort Collins, Colo. 80521

Following a suggestion by Underwood, a difference limen was determined for two-point tactual stimuli, all of which were supraliminal. A signal-detection (TSD) procedure was employed, and consideration was given to subsequent research possibilities in this area.

Underwood (1966) has considered the problem of categorizing the two-point threshold as either a type of absolute threshold (AL) or a difference limen (DL). In the course of his discussion he conjectured that it would be possible to determine how much one would have to change a supraliminal two-point tactual stimulus in order to obtain reliable judgments of "different." Although such a study has apparently not been done, it would amount to the determination of a DL, i.e., finding the physical distance one has to increase or decrease a supraliminal two-point stimulus in order to secure judgments of change. As suggested by Underwood, this is clearly a type of threshold that is different from the usual two-point threshold. This study reports on a theory of signal detection (TSD) approach (Green & Swets, 1966) to the problem posed by Underwood.

METHOD

The Ss were four male students enrolled in child psychology at Colorado State University, who were paid for their participation. The apparatus consisted of four aesthesiometers, one being a standard of 47 mm and the other three unidirectional above the standard in 3-mm steps. The dorsal forearm, with a two-point threshold of 40 mm (Hilgard, 1953), was chosen as the stimulus area. A TSD procedure (Green & Swets, 1966) was employed in which the 47-mm standard was always presented first in a sequence of two stimulus presentations. The two-stimulus sequence is referred to as a trial. The trials followed a random schedule in which one-half of the time the standard was simply repeated while on the additional trials the standard preceded either the 50-, 53-, or 56-mm stimuli. Each S was told that his task was to make comparative judgments of a set of two stimuli presented during a trial. He was asked to respond "same" if the two stimuli of a trial were the same length and to respond "different" if he thought the two stimuli were different in length. He was asked to be as accurate as possible but not to spend too much time on each judgment. If a S reported "different" when the second stimulus of a trial was indeed different, this constituted a "hit," but if he reported "different" during those trials in which the standard was repeated, this was scored as a "false alarm." In this way it was possible to obtain three ROC curves for each S that reflected his sensitivity under the stimulus, i.e., signal, conditions of 50, 53, and 56 mm. The S wore opaque goggles and was seated in a reclining chair. His right or left dorsal forearm, switched each session to alleviate any desensitization, was placed on a rubber pad on an adjacent platform. Two parallel lines, 165 mm in length and 2-3 cm apart, were drawn from the wrist up the middle of the forearm. These lines were then crossed at 90 deg by several other lines drawn at random. This criss-cross pattern assured that E would be using the same plane of the arm and the same locus or point for a set of stimuli. The aesthesiometer was manually placed on the arm as carefully as possible so both points would touch simultaneously. Extraneous cues were minimized by placing each aesthesiometer on a foam rubber pad after each stimulation. The time required to change stimuli was about 2-3 sec in each trial, with 6-8 sec given to recording between trials.

Each experimental session consisted of 96 trials, with a total of seven daily sessions. Thus, each standard-standard trial was presented a total of 336 times and each of the three standard-different combinations was presented a total of 112 times.

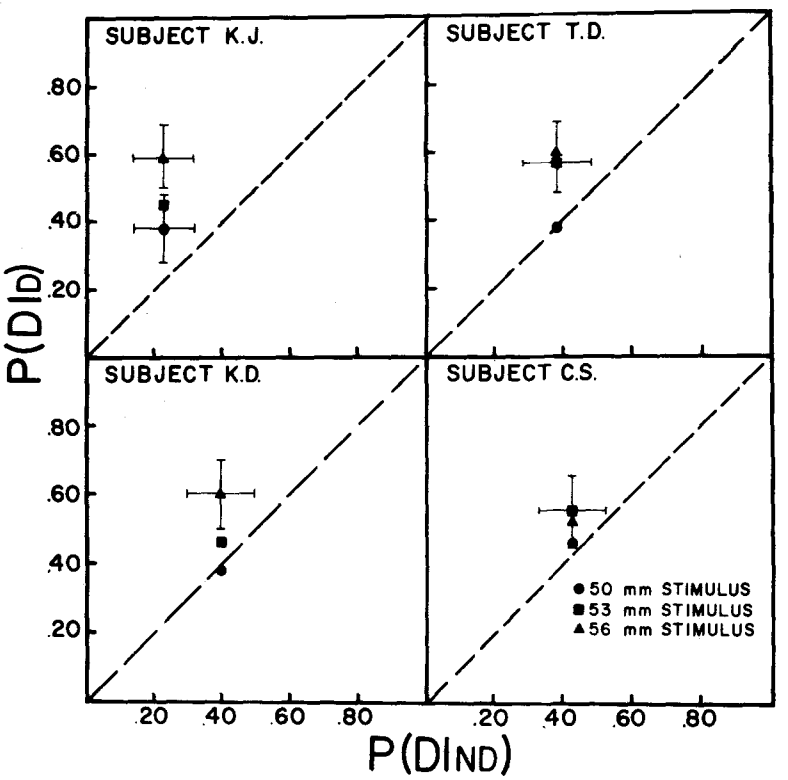

Fig. 1. P(D|D) represents the proportion of "different" responses when the second stimulus was actually different from the standard and (PD|ND) the proportion of "different" responses when the test stimulus was not different from the standard. Bands for the 95% confidence intervals are shown for the various data points when there is a possible question about statistical significance.

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RESULTS AND DISCUSSION

In order to test statistically for sensitivity, the binomial data point in the unit square was calculated for each test stimulus and two 95% confidence bands (one for the proportions of hits, the other for the proportions of false alarms) were calculated for each data point. These results for the four Ss are shown in Fig. 1. It can be seen that K. J. showed significant sensitivity with all test stimuli but that there was a statistically significant increase in sensitivity only between the 50- and the 56-mm stimuli. T. D. was not reliably sensitive at 50 mm but did show sensitivity at 53 and 56 mm, even though these latter values were not different. K. D. demonstrated significant sensitivity only with the 56-mm test stimulus. C. S. exhibited sensitivity minimally at 53 mm, but this broke down at 56 mm for the only inversion of results among the four Ss. The results show considerable individual differences among Ss, but, taken as a whole, it appears that a test stimulus must exceed the standard by more than 6 mm to enable S to reliably report "different." In short, the DL for supraliminal two-point stimuli under the conditions of this study is in excess of 6 mm. The lack of separation of the two larger stimuli for two Ss, T. D. and C. S., as well as the reversal of these two stimuli for C. S., raises a question about what happens as the magnitude of stimuli are further increased. Does the size of the DL change as the magnitude of the test stimuli increases? There is also a need to investigate with supraliminal stimuli that are progressively smaller than a standard. In addition, it would be interesting to look at other body areas where the initial two-point threshold is larger or smaller. Would a comparable DL for such an area reflect the initial difference in the two-point threshold?

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Observation vs performance in learning over the fourth to sixth grades*

MELVIN H. MARX and KATHLEEN MARX
University of Missouri, Columbia, Mo. 65201

Fourth-, fifth-, and sixth-grade children were trained and tested in a multiple-choice learning situation under both performance (guessing with knowledge of results) and observation (watching the performer) conditions. Although the observer superiority previously found for college students and grade-school children did not occur, there was a reliable trend in that direction from the fourth to the sixth grade.

The experimental question examined was whether there is any difference in learning by observation, as contrasted with learning by performance (trial-and-error guessing with knowledge of results) in school children of the fourth, fifth, and sixth grades. Superior multiple-choice maze learning by observation has been found in college students (Hillix & Marx, 1960; Rosenbaum & Schutz, 1967) and grade-school children (Rosenbaum, 1967).

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SUBJECTS

A total of 140 school children from the fourth, fifth, and sixth grades of a Columbia, Missouri, public school were tested. Two classes from each of the grades were used.

APPARATUS

Stimulus presentation was by means of a Kodak Ektagraphic 2 x 2 in. slide projector (Model AF) and a Radiant Super Champion 40-in. screen. The stimuli consisted of 10 sets of four animals, labeled A, B, C, and D, used as described below. Responses in training trials utilized self-scoring devices called Rapid Raters, manufactured by Research Media, Inc. These small pressboard devices had two columns of 20 items each, with response alternatives A, B, C, and D. Responses were made by inserting a metal stylus into the appropriate hole; the device was modified so that correct answers allowed the stylus to proceed to its hilt, whereas incorrect answers stopped the stylus (by means of a template inserted into the device). Paper answer sheets were perforated by each stylus entry, leaving a permanent record of training responses. Styluses were made by inserting a small nail into the rubber eraser of a standard No. 2 lead pencil. Test answer sheets were mimeographed and required S to write his answer (A, B, C, or D) with the pencil, with no knowledge of results.

PROCEDURE

Each class was tested in the usual classroom. The children were told that they were to participate in an experiment whose purpose was to compare different methods of learning. Their task was to guess which animal from a set of four had been selected as the "correct" one of that set; if their guess was correct, as shown by the full entrance of the stylus into the Rapid Rater, they were to remember that animal, because it would be correct on all future trials. If their guess was wrong, as indicated by the blocking of the stylus, they were to try some other animal on future trials. They were also told not to try to remember the letters, since these identifications for particular animals changed from trial to trial as the positions of the animals changed (randomly determined), although the composition of the sets did not vary (that is, the same four animals always appeared together).

The class was divided into pairs of Ss of the same sex and approximately equal levels of achievement, as rated by the teacher, and one member of each pair was assigned to either the "red team" (left-side S) or the "green team" (right-side S). Red team members performed for the first five sets of animals; that is, the performer did the guessing and used the Rapid Rater, while his partner simply observed his response and its consequence. Then the roles were reversed for the next five sets, which completed the first training trial. Four such training trials were given (except for one sixth-grade class, where time permitted only three trials), with varying orders of sets as well as varied positions of the animals within the sets.

After each training trial a retention test was administered, so that learning under both performance and observation conditions could be compared (there being, of course, no overt record available of observational learning in training). These trials utilized the same kind of stimulus presentation, but with new orders of animal sets and of positions of animals in the slides. The Ss answered on mimeographed test sheets. Pairs of Ss were