

1954

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Recommended Citation

Pfefferkorn, Robert G. (1954) "Apparatus for Measurement of Reaction Time to Complex Differential Stimuli Presented as a Standard Rate in Nonrepetitive Series," *Proceedings of the Iowa Academy of Science*: Vol. 61: No. 1 , Article 52.
Available at: <https://scholarworks.uni.edu/pias/vol61/iss1/52>

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Apparatus for Measurement of Reaction Time to Complex Differential Stimuli Presented as a Standard Rate in Nonrepetitive Series

By ROBERT G. PFEFFERKORN

The development of reaction time measurement methodology from the experimentations of Donders has been distinguished primarily by inventions of more accurate and reliable measuring instruments (5). Methodology and content have been changed but little and in fact have been simplified and condensed from the elaborate formulations of early psychophysics.

On logical grounds speed of reaction has been postulated as an important trait positively related to the successful performance of certain psychomotor skills, e.g., driving a motor vehicle. However, experimental evidence to support this hypothesis has been inconsistent. Mostly the relationships to such performance have been found to be low. One study has demonstrated a negative relationship between speed of reaction and success in operating a motor vehicle (3).

Bartlett (1) and Conrad (2) have cited certain objections to relating the data of typical psychophysical experiments to behavior outside the laboratory. These investigators object particularly to the discrete nature of the stimulus typical of psychophysical methodology. Bartlett has observed that in everyday life individuals are confronted with complex series stimuli. Conrad has added that such series stimuli are permutative but not repetitive.

THE PROBLEM

The apparatus described here was designed to measure speed, accuracy and variability of response as a function of complex, differential, noniterative stimuli presented at a constant rate.

APPARATUS

The stimuli. Each stimulus presentation consists of groups of five Latin crosses forming a pattern of one central cross and four peripheral crosses. A sample presentation is shown in figure 1. The Latin crosses are used as stimulus patterns because of their inherent design. Experiments conducted by the Air Force School of Aviation Medicine (4) indicate that no little discrimination is required for identification and perception of direction of this figure.

Stimuli presentation board. Stimuli are presented within a 34- $\frac{1}{2}$ " square made of $\frac{3}{4}$ " plywood. Crosses are formed from .15 amp., type T47, 6-volt miniature bulbs mounted within $\frac{1}{2}$ " holes through the plywood. The bulbs are masked by No. 2108 $\frac{1}{8}$ " green translucent plexiglas sheeting which forms a facade for the entire panel. Use of translucent plexiglas permits light to be transmitted but is sufficiently dense to make the panel invisible to Ss. There are five banks of 17 bulbs each mounted in the panel. Each bank of bulbs consists of a central light surrounded by two concentric rings of eight lights each separated by increments of one inch measured from the edges of the holes. Since each light aperture is $\frac{1}{2}$ " in diameter, each bank of lights is 6- $\frac{1}{2}$ " in diameter. Use of these groups of 17 lights permits crosses to be formed in any of eight possible directions, i.e., at 45° intervals. Thus, considering the panel as a unit, there are 32,768 possible combinations and permutations of different five-cross patterns.

A SAMPLE PRESENTATION OF SERIES STIMULI

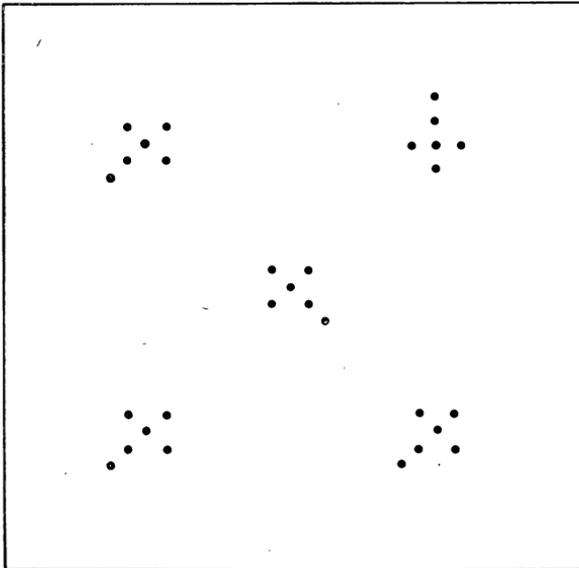


FIGURE 1

Control panel. Stimulus patterns are set up from 12 five-gang, 12-position rotary switches and 10 two-position lever switches mounted on a standard desk type open relay rack. Any given *on* position of a rotary switch controls the peripheral light in each of the crosses for a given presentation. For each presentation the cen-

tral lights of all crosses are the same and are wired as a separate circuit. The other four lights forming the balance of each cross pattern is established by one or the other position of each of five toggle switches. Thus for a given presentation of five crosses it is necessary to move a rotary switch one position and move each of five toggle switches either up or down. The circuit is so designed that presentations may be established in advance. Thus while S reacts to a given presentation, the immediately subsequent pattern can be preset by E. This arrangement of circuits is made possible by the use of relays and alternate groups of switches. Since 12 rotary switches are employed, each controlling 11 patterns, there are a total number of 132 patterns. These patterns are all different.

Stimuli patterns and rate of presentation. There are five general stimulus patterns. For each presentation the number of crosses with the longer axis pointing in the same direction are zero, two, three, four or five according to the patterns set up by E. Figure 1 illustrates a pattern in which the longer axes of three crosses are aligned. S is instructed to give a "yes" response for three crosses aligned and a "no" response for any other presentation. The procedure by which S responds will be described subsequently.

Stimuli are presented at regular five-second intervals by means of a Haydon synchronous motor, cam and microswitch. This interval of presentation is maintained for each subject regardless of whether or not S responds to each presentation. Thus if S fails to respond to a given pattern after five seconds exposure this pattern is replaced by another. If S reacts before a given pattern is withdrawn, the circuit is designed so that simultaneously with S's reaction the pattern is extinguished for the remainder of the five-second interval.

Of the total number of 132 patterns there are 50 three-cross aligned patterns, 29 two-cross aligned patterns, 28 four-cross aligned patterns, 17 zero-cross aligned patterns and 8 five-cross aligned patterns.

Method of response. S is seated in a chair equipped with a hydraulic lift at a distance of seven feet from the panel. S is seated with his eyes level with the center cross thus viewing the panel at the normal angle. The horizontal and vertical visual angle is constant for all patterns at $11^{\circ}36'$ for the panel used in this study.

The right arm of the subject's chair is equipped with a three position, spring return, (center-off) Telever toggle switch. S responds by an abducting movement of the right thumb and index

finger moving the switch to the right if he perceives three crosses aligned. An adducting movement of moving the switch to the left is made if S perceives one of the other patterns.

SUMMARY

An apparatus is described for the measurement of speed, variability and accuracy of response to presentations of groups of Latin crosses presented at a constant rate in nonrepetitive series.

Certain details of the stimulus presentation board, control panel, stimulus patterns, rate of presentation as well as methods of response and recording of responses are described.

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