

## A STUDY OF DISCRETE REACTIONS

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(Introduced by Coleman R. Griffith)

It is now commonly known that the transmission of nervous impulses from one part of the body to another is not instantaneous. The bare statement of this fact does not dismiss reaction time as a possible field of investigation. To say that the nervous system takes time to act tells only a part of the facts, for there is left unanswered a variety of questions concerning the speed with which different kinds of stimuli are carried from receptor organs to effector muscles. Quickness is an attribute of the nervous system but is this degree of quickness affected by the simplicity or complexity of the stimuli, and if so to what extent.

A cursory view of the field of reaction time makes it plain that there are four general types of reaction, namely: discrete, serial, confluent, and associative. The start of a dash man in track nicely illustrates a discrete reaction. The runner has to react to but one stimulus and that is the firing of a gun. From the moment the gun is fired until the race is over he makes the same kind of movements. The football halfback is making a serial type of reaction when he is running with the ball in a broken field. He must run away from this man, pivot around another, and follow his interference. His behavior consists of a series of reactions to different discrete stimuli. A safety man in football makes a confluent reaction when he attempts to follow with his eyes the path of the kicked ball. Here the stimulus is always present and he must constantly try to keep track of it. Golfers do the same thing when they attempt to follow the flight of a driven golf ball. In either case any lapse in reaction to the stimulus is likely to result in losing sight of the ball. The fourth type of reaction namely, associative, is made when a subject responds to a list of words by giving their opposites or whatever they call to his mind. This type of reaction is frequently employed in so-called tests of intelligence and lists of words like the one prepared by Kent and Rosanoff.

This paper is concerned only with discrete reactions which are, as illustrated, single responses to a more or less complex stimulus. Discrete reactions may in turn be divided into two groups namely, simple and

complex. The dash man's response to the gun was a simple discrete reaction. A relay man makes a complex discrete reaction in receiving from his teammate a baton and then running his distance. Several stimuli occurring almost simultaneously start him on his course, while only one starts the dash man. The difference between simple and discrete reaction is the number of stimuli which prompt an individual to a single course of action. A question may now be asked as to which class of discrete stimuli an individual will react the more rapidly.

A study of the discrete reaction of one-hundred and twenty Freshmen in the Athletic Coaching School. All of the subjects, with two exceptions, were tested by the same experimenter. All of the examinations were made between September 21 and November 20, 1929.

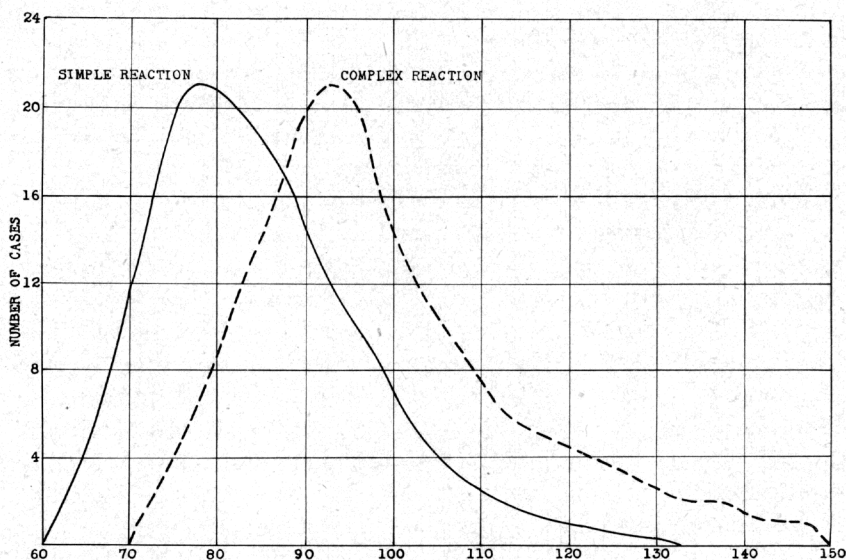
The testing method and apparatus have been in use in the Laboratories for Research in Athletics for some time. The technique has been developed through the experience of testing over four-hundred men and has been used by over thirty different experimenters. Dunlap's reaction time apparatus is the one employed in the Laboratory. It is accurate to the nearest five-hundredth of a second. Auditory, visual, and tactual or muscular stimuli may be given by the apparatus.

The following illustrates how the experiment was conducted upon each subject. After the apparatus was explained several practice trials were taken, so that the subject would understand and do what was expected of him. The subject reacted by pressing on a finger response key. This permitted him to make a rapid reaction with a very small amount of movement. The first group of tests were of simple discrete reaction. Before every stimulus the subject was warned with the words "Ready! Now!" First a light was made to flash before the subject's eyes to which he responded by pressing on the response key as quickly as he could. After five such trials his auditory and tactual times were tested. In the fourth and fifth tests the subject instead of tapping with his finger shouted into a voice key, which looks and operates somewhat like a microphone. The stimuli used were a loud click and a shouted word. These tests completed the simple reaction time examination.

The tests of complex discrete reaction employed the same apparatus and stimuli as did the preceding tests. The first part of the complex group is called a test of simple choice. The subject was given any of the following stimuli in a chance order, a light, sound, or a pressure. The subject was warned before each stimulus in the usual manner, but he was not told what kind of a stimulus to expect. The test of complex choice came next. It is the same as the simple choice except that no warning signal is given before any stimulus. The selective test was the

next. In the first part the subject is to respond to light but not to a sound. In the second part he is to do the opposite namely, respond to the sound but not to the light. In both cases the light and sound are given in a haphazard order. The warning signal is given before each stimulus. The last part of this group is called the irregular test. In it the subject is warned of the coming stimulus but the stimulus does not come at any regular time after the warning. The stimuli are first a series of sounds and then a series of light flashes.

In order to get a distribution of the above tests each man's simple discrete reaction and complex discrete reaction scores were averaged separately. Twenty-five samples made up the simple discrete reaction



average while ninety samples made the complex average. The resulting averages were then plotted. Each curve was beautifully near a normal distribution.

When both curves are plotted on the same baseline there is some overlapping. However eighty-six per cent of the simple discrete scores reach or exceed the median of the complex distribution. Thus statistically simple reaction is shown to be significantly faster than the complex. The arithmetical average of the simple reaction is 82/500ths of a second while the average of the complex distribution is 97/500ths of a second. The difference between the two averages is significantly different.

A question arises as to whether the fastest men at the simple reaction are the fastest at the complex reaction. According to the principle of organic quality the fastest men in one group should be among the fastest in the other. This was found to be true. The coefficient of correlation between the two groups was a positive .70 and the probable error was  $\pm .061$ .

From the study the following suggestive conclusions were drawn:

1. That individual differences exist between simple and complex discrete reaction.
2. That individuals are slower in responding to complex discrete stimulation than they are in reacting to simple discrete stimulation.
3. That the probabilities are in favor of the fastest reactors to a simple discrete stimulus being among the fastest reactors to a complex stimulus.
4. That coaches can make use of these results by simplifying football charging signals to secure faster charging teams.