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A New Eye-Hand Coordination Test

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A NEW EYE-HAND COÖRDINATION TEST

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The purpose of this study is to devise an apparatus which will measure the type of eye-hand coördination found in automobile driving. The apparatus is of the serial reaction type, the total performance time being measured in hundredths of a second.

APPARATUS

The subject is seated at a table (69 cm. x 107 cm.). Directly in front of him is an automobile steering wheel, with a horn button mounted at the center of the wheel. At his right is a standard gear shift lever; at his left is a hand brake. At the back of the table and facing S is a vertical screen (60 cm. x 92 cm.) containing 14 irregularly spaced visual instructions. In many instances, these instructions are reproductions of actual highway signs, such as the hexagonal yellow stop sign, and the black arrow on a yellow background denoting a turn to the left or right. Other printed instructions are included, such as, "shift to reverse," "horn," "shift to high." Each one of these visual stimuli may be illuminated by a six-volt bulb mounted directly behind the stimulus. S is asked to make the response suggested by the stimulus as soon as the sign is illuminated. A switch is mounted on the front right hand part of the table so that S may start the experiment himself. By throwing this switch, the first stimulus is illuminated. When S makes the correct response to the first stimulus, the second visual instruction appears immediately. A correct response to the second stimulus provides the third instruction, etc. The last instruction of the series is, "switch off." When S throws off the switch, the experiment is ended. The time elapsing from the beginning of the experiment to the end is measured in hundredths of a second (by a Standard Electric Precision Timer), and this time is regarded as the score for that trial. In other words, this apparatus measures serial reaction time. If S makes an incorrect response, he is penalized by the time factor only.

Mounted separately behind the table is the control board and the timer. These are mounted separately from the table in order that they may be free from jars which may result from S's manipulation of the response levers. The control board consists of a series of 14 electromagnets, one mounted below the other. Each electromagnet is wired to its respective response lever. When S makes his response, the activated electromagnet attracts a freely swinging hook which allows a brush to fall to the hook directly below, closing a new circuit which provides S with the next visual stimulus. The brush is a T-shaped piece of brass which falls freely on a vertical track, the common contact pole. Parallel to the track are 14 individual contact points placed directly opposite their respective electromagnets. As the brush passes an individual contact point, it closes a circuit to the appropriate stimulus light.

The apparatus works on 110 volts with transformers of 6 and 18 volts for the lights and electromagnets respectively. The circuit through the transformers and the precision timer goes through the switch mounted on the table — the switch which starts and stops the apparatus.

In this test, the stimuli, as stated above, are in the form of visual signals. Since in the driving situation the individual must respond to a variety of signals which appear in both direct and peripheral vision, the stimuli on the apparatus have been so arranged that they appear at random in S's direct and peripheral vision.

The apparatus has been kept simple in order that it may be used as a measure of eye-hand coördination for non-drivers as well as drivers. It has been found that little or no more time is required to instruct non-drivers in the use of the apparatus than to instruct drivers.

PROCEDURE

So far, each of 100 students of Grinnell College, 34 men and 66 women, has taken three trials on this test of eye-hand coördination. The following standard instructions were read to S: "This is a test of eye-hand coördination. There are on this panel 14 different instructions which will be illuminated in a random order. Your task is to respond to the instructions as rapidly as possible. For example, if the instruction, "turn right," is illuminated, you are to turn the steering wheel a quarter turn to the right. The instruction, "stop," means that you should pull the hand brake toward you, etc. (Demonstration) You will determine the rapidity with which the visual stimuli appear, because a new instruction will appear only when and if you make the correct response to the current instruction. The time you require to complete the 14 instructions will be your score. Please notice that the last instruction will be, "switch off." This means that you should turn off this switch on the right hand edge of the table. When you are ready to start the experiment you may do so by turning on the switch."

A questionnaire was filled out by each subject in order that the following data might be obtained: age, handedness, years of driving, miles driven per year, average speed, and major and minor accidents.

Results

The data acquired to date are rather meager, but they do indicate some interesting trends. The spread of scores for the 100 subjects ranges from 15.9 seconds to 54.4 seconds on the first trial, and 13.7 seconds to 50.4 seconds for the third trial.

The following table lists in seconds the averages of the scores on this test:

Table I — Average Reaction Times in Seconds

Trial	1	2	3
Total group	25.00	22.57	21.44
Men			
Drivers	23.21	20.66	18.39
Non-drivers	25.84	22.56	20.81
Total	23.74	20.77	18.56
Women			
Drivers	24.49	22.21	21.55
Non-drivers	30.45	27.83	23.98
Total	25.85	23.48	21.76

From this table, the following observations are made: (1) the men as a group have a faster reaction time than women; (2) automobile drivers among both men and women have a faster reaction time than non-drivers; (3) learning takes place on succeeding trials. This is apparent from the fact that all the group averages are faster on succeeding trials. This is also evident from the fact that 85 of the 100 subjects improved their scores on succeeding trials, with only 15 of the 100 making slower scores.

While this test is not a diagnostic one, it has been interesting to observe that there are three different types of people receiving slow reaction times: First, the individual who is naturally slow in making responses makes a slow reaction time; second, the individual who makes frequent errors increases his time; and third, the individual who gets rattled when he makes an incorrect response increases his score.

Little has been done to date by way of validating the data in terms of accident proneness. It is hoped that eventually this test may be given to several drivers who have had accidents, in order

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that the scores of these drivers may be studied in relation to the scores earned by drivers without accidents. Only two of the subjects tested so far have had major accidents, but it is worth noting that one of these, a girl, has the slowest reaction time of all students tested, and the other, a boy, has the second fastest reaction time of all men tested. These results are consistent with those of other investigators who found the extreme reaction times are related to accident proneness.

CONCLUSION

To date, the results show that on this test of eye-hand coördination (1) men have a faster reaction time than women, (2) drivers have a faster reaction than non-drivers, (3) learning takes place through three succeeding trials. This investigations are to be continued with the hope that further classifications may be determined.

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