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Age and Handedness as Factors in the Performance of a Complex Pursuit Task: Results of a Study at the Iowa State Fair

By GUY H. MILES AND DON LEWIS

In connection with systematic studies of the underlying variables which affect the learning and retention of complex skills, it has been found that certain patterns of response—the steering and pointing patterns, in particular—are firmly ingrained in the average person before adulthood is reached. They are so rigidly fixed that alterations of them are extremely difficult to produce in reasonable lengths of time, under laboratory conditions. They depend on a high degree of coordination of perceptual and motor components of behavior, and are presumably acquired during many years of reinforced practice. Steering left when turning right is desired is seemingly as behaviorally abhorrent as pointing up when pointing down is the thing to do.

The purpose of the present investigation, made last summer at the State Fair in Des Moines, was to determine whether age and handedness are factors in the performance of a task requiring responses basically like the ordinary ones of steering and pointing. It was hoped that the results would reveal something about the way the steering and pointing habits grow, indicate the approximate age at which they become fully developed, and disclose any interactions between the effects of age and handedness.

The original plan had been to obtain right- and left-handed boys of different ages from schools in Iowa City and nearby towns. However, an excellent opportunity for obtaining subjects was offered when University officials requested that psychological research be put on display at the Fair. The feasibility of gathering useful data under such seemingly adverse conditions was seriously questioned. Psychological experiments are supposed to be conducted in the laboratory, away from noise and confusion. But full consideration was given to the long-range benefits that might accrue if psychologists, in order to obtain the kinds of subjects they sorely need for special purposes, could be made to feel secure in leaving their laboratories and carrying their experiments to the locations where subjects abound. So the venture was taken; and the question as to whether or not useful data can be obtained under conditions such as those prevailing at the Fair became, in itself, an important feature of the investigation.

APPARATUS

The task was provided by the Iowa Pursuimeter, the essential features of which are shown in Figure 1. It is a modified form of the Iowa Pursuit Apparatus, described elsewhere (1,3). It is a miniature mockup of the old Turret Pursuit Apparatus (4). The subject makes responses like the ordinary ones of steering and pointing, in his efforts to keep a spot of light on a moving target.

The target, a 1-inch square area painted in the center of a flat surface 11 inches square, is located at the end of a boom, about

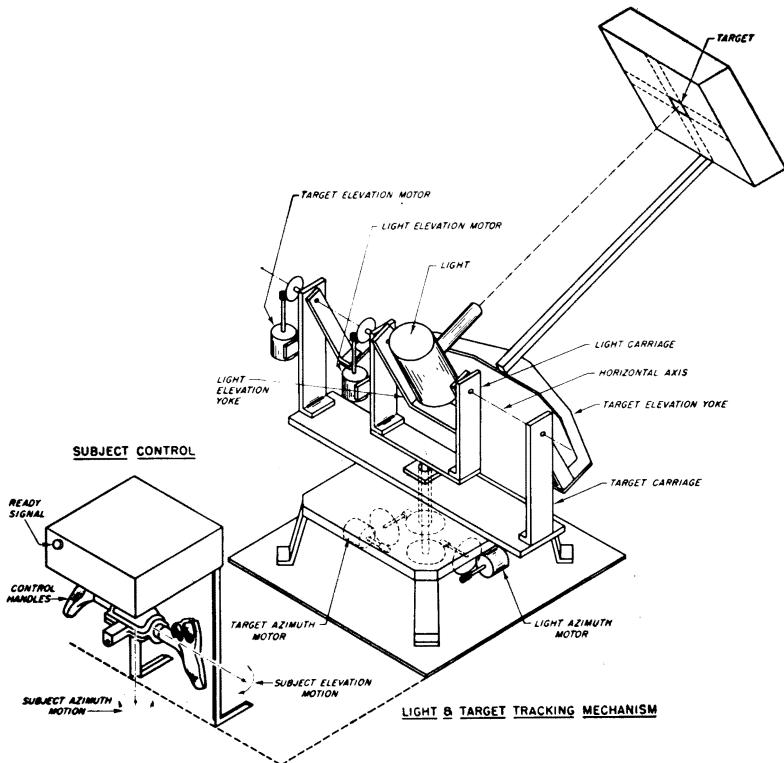


Figure 1. Schematic drawing showing the principal features of the Pursuimeter.

five feet from the subject's face. It moves through the same irregular pathway during each 30-second trial period, being returned automatically to the starting point during the rest interval between trials. The position of the spot of light, which the subject strives to keep on the target, is controlled through movements of the response unit. The subject, sitting on a chair, grasps two pistol-grip type handles placed at about chest height. To move the light to the right or left, the handles and the movable structure to which they are at-

tached are turned through a small angle by pushing one handle away while pulling the other toward the body. This is the steering response. To make the light go up, the bottoms of the handles are pushed a short distance away from the subject, in a kind of twisting action, and to make it go down, the handles are pulled toward the subject. This is basically a pointing or aiming response. The speed with which the light moves in any direction depends on how far the handles are turned from the neutral position.

The Pursuitemeter was set up in a booth surrounded by other scientific displays. The subject was seated with his back toward an aisle through which fairgoers walked. The allotted space was too small to allow for a separating barrier between the subject and the spectators. When a subject was performing, large numbers of on-lookers crowded around. Interestingly enough, the on-lookers respected the subject's rights.

SUBJECTS AND PROCEDURES

The subjects were male volunteers from the crowd. The call for a volunteer: "Is there a left-handed boy who wants to try keeping the light on the target?" If a subject said that he ate, wrote, or threw a ball (any two of these) with his left hand, he was accepted as a lefthander. As soon as one subject had completed his trials, the experimenter called for another volunteer unless, as was usually the case, several boys were standing in line waiting for a turn. In view of the scarcity of lefthanders, a lefthander waiting in line was always run ahead of any righthanders. Despite every effort it was not possible to obtain equal numbers of right- and lefthanders at the different age levels. Four principal age groups were set up: years 9-10, 11-12, 13-14, and 15-16. Another group composed of subjects ranging in age from 17 to 35 years was also run. Unfortunately, very few boys younger than 9 turned up.

Each subject was given a total of 10 trials. Each trial was 30 seconds in length, and the trials were separated by 30-second rest intervals. The score for each trial was the time in seconds that the spot of light was kept on the target. Previous studies with the Pursuitemeter had shown that performance curves begin to level off after about 10 trials. It was felt that the additional information that might be obtained from giving each subject more than 10 trials would be more than offset by the increase in the number of subjects who could be run each day. The "show" was open for business 10 hours per day for 10 consecutive days.

There were 32 subjects in each of the five age groups. Of these, 20 were righthanders and 12 lefthanders.

RESULTS

The results are summarized in Figure 2, where means of the time on target (in seconds) are plotted against trials (in blocks of two). Curves are shown for the four younger age groups only.

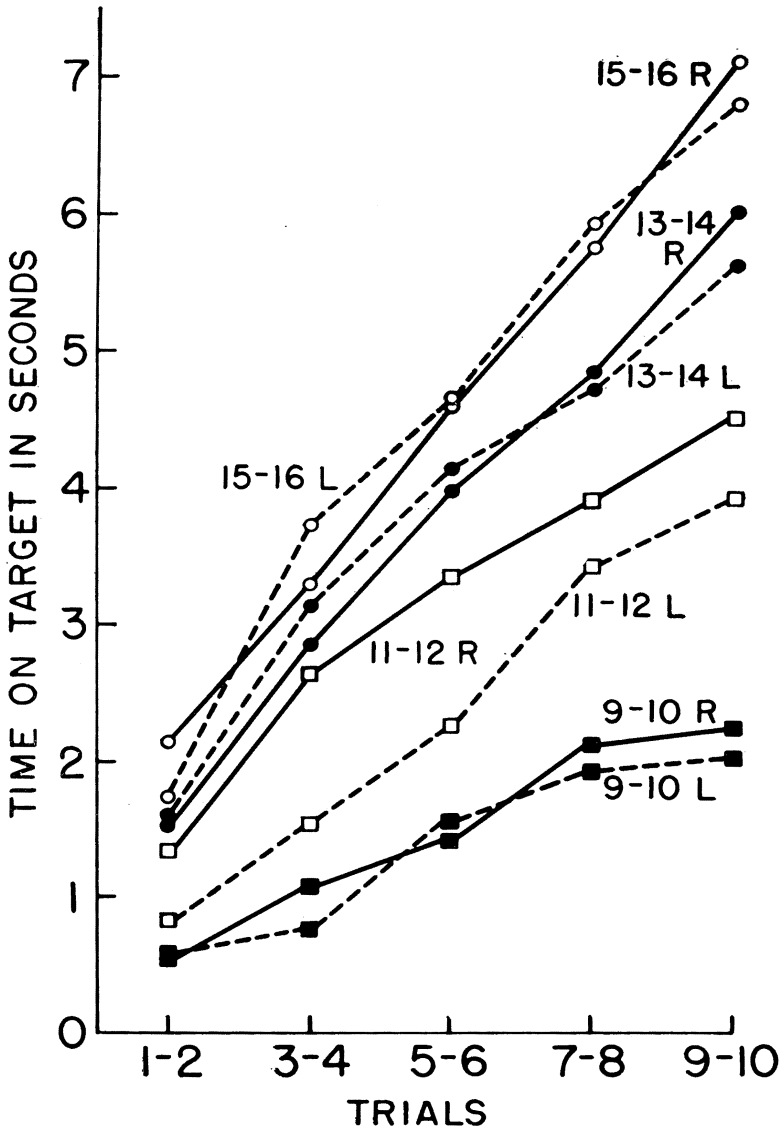


Figure 2. A plot of means of time on target per trial during ten 30-second trials on the Iowa Pursuitmeter for four different age groups of lefthanded and righthanded male subjects. The means are averages over blocks of two trials. R = righthanders; L = lefthanders.

The curves for the 17-35 age group were almost identical with those for the 15-16 group, so there was no indication of improvement in performance beyond age 16. The dashed-line curves are for lefthanders, the solid-line curves for righthanders.

The only apparent difference between the performances of the handedness groups occurred at the 11-12 age level, where the righthanders performed consistently better than the lefthanders did. The difference, however, was not statistically dependable. (The probability that the difference resulted from chance factors in sampling was around .50.)

Because the performances of the handedness groups did not differ significantly, the data for each age group were combined for a study of the age variable. Figure 3 summarizes the combined data. Here again, means of time on target per trial are plotted against trials, in blocks of two. The curves for the four age groups differ from each other in slope as well as in general level, with the younger subjects beginning at a lower point and learning relatively less during the ten practice trials.

A trend analysis (of the age data) revealed that the means of performance and also the slopes of the curves were significantly different at better than the 0.1% level. However, when the data were separately analyzed for adjacent age groups, it was found that the difference between overall means for the 9-10 and 11-12 groups was significant at the 1% level, for the 11-12 and 13-14 groups at the 10% level, and for the 13-14 and 15-16 groups at only the 20% level.

The divergence (difference in slopes) of curves for adjacent age groups was found to be significant at the 2.5% level for the 9-10 and 11-12 groups, but was not significant for other adjacent pairs. However, a comparison of 11-12-year performance with 15-16 performance indicated that the slopes were significantly different at the 0.1% level. This finding suggests that perhaps all of the slopes are different even though the probabilities that the empirical differences arose through chance factors were not satisfactorily small.

DISCUSSION

A discussion of the effects of handedness on Pursuitemeter performance might seem to be unnecessary since there were no dependably significant differences between the overall means of left- and righthanded subjects. However, a "true" difference at ages 11-12 is suggested by the data—a difference in the direction and at the approximate age demanded by prior conjectures on the part of the writers. It was hypothesized that, around 11 or 12 years of age, most boys begin very actively to use tools and other mechanisms designed specifically for the righthanded person. The left-handed child, in learning to use these devices, would have to change

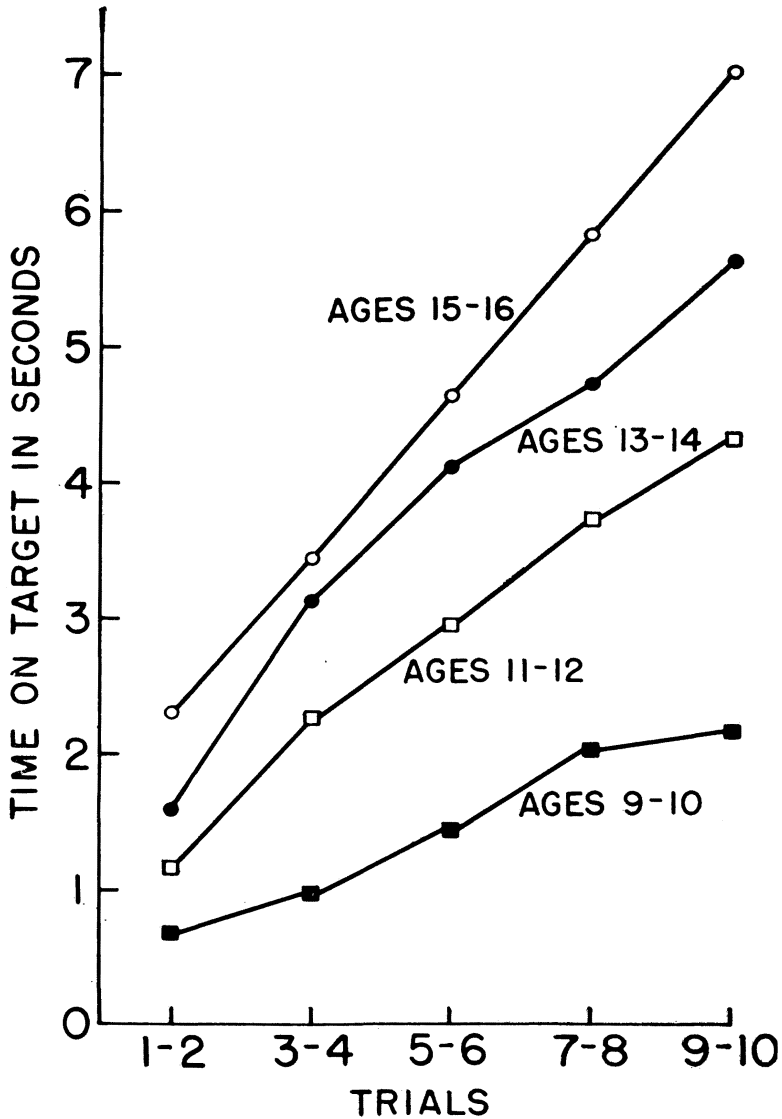


Figure 3. A plot of means of time on target per trial during ten 30-second trials on the Iowa Pursuimeter for four different age groups of male subjects. As in Figure 1, the means are averages over blocks of two trials. $N = 32$ per group.

to some extent from left-to righthanded response patterns. Conflicting response tendencies should arise and should be reflected in a lower performance on any task not inherently either left-or righthanded.

Presumably there are marked individual differences among

children with respect to the age at which they begin actively to manipulate specialized righthanded equipment. Consequently, the division of subjects on the basis of age alone (as occurred in the present study) might tend to obscure the effects of competing response tendencies. The actual difference in performance for the 11-12 year subjects suggests that further research on handedness might prove fruitful.

Age was shown to be a factor not only in overall level of performance but also in determining the relative rate of learning. The most reasonable explanation of these findings is that performance on the task reflects physical maturation and the presence of facilitative attitudes or sets toward the task, along with appropriate steering and aiming response tendencies acquired in everyday practice. Several factors which are facilitative of motor performance (reaction time, strength, endurance, etc.) have been found by other investigators (2, 6) to be almost fully matured by age 14. Ability to execute precise movements increases rapidly between the ages of 14 and 15 (5, 6). All of these factors would be expected to affect the acquisition of the steering and aiming responses and thus the performance of the Pursuitemeter task. The present results strongly suggest that the steering and aiming responses are completely learned by age 16.

The probable importance of attitudinal and/or postural sets toward the task is evidenced by marked individual differences in performance at each age level. (Similar performance differences among individuals appear in laboratory studies). Four of the adult subjects performed at a level below the mean level of the 9-10 year group. These differences cannot reasonably be attributed to maturational factors nor to practice of the steering and aiming responses. An explanation in terms of motivational differences does not seem reasonable in view of the fact that all subjects appeared to be highly motivated.

Attitudinal and postural sets toward new situations, including methods of approach to new situations, are learned habit patterns. The particular sets which any individual has in relation to a new task may be either facilitative or interfering. In relation to tasks requiring the precise co-ordination of two or more motor responses, an analytical and methodical set might be facilitative, while a set for working quickly and carelessly would be detrimental to performance. The possible facilitating and interfering effects of different sets on perceptual-motor performance have not been investigated. Research in this area is needed.

Finally, what can be said of the feasibility of obtaining useful information under non-laboratory conditions? The results were generally encouraging. The performance data for the subjects between

15 and 35 years of age were compared with similar data for college students, obtained in the laboratory. The average performance level of the State Fair subjects was above that of the laboratory subjects, on every trial. The shapes of the performance curves, and the range of individual differences in performance, were similar.

The superior performance of the State Fair subjects may have been due either to greater motivation or to a better understanding of the task gained through watching the performance of others. Greater motivation is believed to have been the major factor. An unmistakable eagerness to do well, seldom matched by college students serving in the laboratory, was the common rule.

The greatest difficulty was encountered with the younger boys. Most of the parents were highly motivated to spur their children on. It was often necessary to remind the parents of the younger boys that the experimenters wished to determine how well the boys could learn the task, not how well their parents could coach them.

SUMMARY

The effects of age and handedness on the performance of a complex pursuit task involving steering and aiming responses, were investigated in the unusual surroundings of the Iowa State Fair science exhibit. The subjects were 160 male volunteers from among the fairgoers, ranging in age from 9 to 35 years. The obtained data were judged to be reliable.

The only effect, if any, of handedness on performance was found at the 11-12 year level. Age was found to be a significant factor in determining both the rate of acquisition of skill and the overall level of performance. Skill in performing the task improved rapidly from 9 to 12 and more slowly from 12 to 16 years of age, after which there was no apparent change.

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