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GF17  S72
End-Spurt Phenomenon
on a Simple Motor Task
1974

by
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Presented to the School of Education
California State College, Bakersfield, California
in partial fulfillment
of requirements for the degree of
Master of Arts in
Education

October 1974
Approved:

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SECTION I

INTRODUCTION

Researchers involved in measuring motor performance are occasionally confronted with a sharp and unexpected rise in their subjects' performance near the end of a long testing period. This is especially puzzling since it has occurred in investigations where neither learning or physical fatigue are experimental factors. This confusing and unexplained change in performance has been labeled the end-spurt phenomenon.

If end-spurt can be intentionally produced and the major conditions that lead to its occurrence identified, researchers should be able to either intentionally produce or avoid its occurrence. In certain motor performance testing situations when subjects have to perform in a long series of trials, it is possible for an experimenter to unintentionally affect the subjects' motor performance. If end-spurt is unintentionally produced by some inadvertent action by the experimenter, it will contaminate the final performance score which will tend to distort the overall performance score. For example, near

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1Dr. Jim Whitley in an interview with this author on October 15, 1973, at California State College, Bakersfield, expressed his interest in this phenomenon and collaborated on this particular research design.
the end of a long testing period the experimenter, in an attempt to maximize the subject's performance, may unintentionally inform the subject that he is near the end of the trials. This action could serve as an incentive for the subject to increase his intent to respond and result in a significant increase in performance. The present study will demonstrate that any information interjected concerning the length of the task would serve to destroy any potential value the research might have had. This experiment will further indicate the need to exercise rigid control over testing procedures in studies involving motor performance under conditions that might encourage end-spurt.

Two factors argue against the occurrence of end-spurt as merely a chance occurrence. The first is the frequency with which end-spurt occurs. Many experimenters have found their performance curves confounded by sharp rises near the end of testing periods. This phenomenon has also confronted researchers near the end of practice trials prior to the experimental trials. There has been little investigation concerning the reasons for these distorted performance curves. Too often, these performance increases have been explained as merely chance occurrences.

The second factor that argues against end-spurt being a chance occurrence is the evidence supplied by the two studies (Bergum and Lehr, 1963; Catalano, 1973) that have directly investigated end-spurt. Both of these studies found that an
end-spurt did occur.

In this study a simple motor task (grip strength) was employed under conditions designed to illicit an end-spurt. The purpose of this study was to determine whether end-spurt is a real phenomenon that can be produced intentionally.
Most of the information concerning the end-spurt phenomenon has been supplied by experimental and industrial psychologists. Most of these psychologists agree there is an end-spurt phenomenon in cognitive and motor performance. Despite this agreement among psychologists, there is very little experimental evidence with which to confirm or deny the existence of such a phenomenon. The end-spurt phenomenon is referred to in several psychological references (Wyatt and Langdon, 1932; Ryan, 1947; Bartley and Chute, 1947; Woodworth and Schlosberg, 1954; Hilgard and Marquis, 1961; Andreas, 1962; and Duffy, 1962). Despite these references, most of the information is based on speculation rather than empirical evidence. However, these sources seem to agree that end-spurt is more likely to occur when the subject is aware he is near the end of the task and when the testing period has been a long one.

The first empirical study (Bergum and Lehr, 1963) that investigated the end-spurt phenomenon employed a vigilance situation in its design. In this study, subjects pressed buttons upon detection of the omission of a light in an ordered sequence of signal lights. The subjects, who had
knowledge of both the length of the vigil and their present point in the vigil, demonstrated an end-spurt during the final testing period. An end-spurt did not occur in the performance of the control subjects, who were not supplied with the information concerning the end of the task.

This author was able to find only one other empirical study (Catalano, 1973) that was designed to investigate end-spurt. Catalano conducted two experiments, one in which a vigilance task was employed and on the other a rotary pursuit tracking task was used. In both of these experiments an attempt was made to determine the temporal limits within which end-spurt might occur. In both experiments end-spurt occurred when the subjects were led to believe the task was ninety per cent completed. Further research was suggested to determine why ninety per cent completion elicited end-spurt and why other percentages failed to illicit this phenomenon.

The studies (Bergum and Lehr, Catalano) designed to directly investigate end-spurt provide at least a beginning for the understanding and control of this phenomenon. The scarcity of evidence concerning this phenomenon has led this author to undertake a study to add to what is known about the end-spurt phenomenon.
SECTION III
DESIGN AND PROCEDURES

Subjects:

Thirty high school boys served as subjects for this experiment. They were selected by their physical education instructors. The only request made by the experimenter was that they choose consistent attenders to facilitate the study.

Apparatus:

The instrument used to measure grip strength was an adjustable grip dynamometer calibrated in kilograms. The dynamometer was adjusted to a setting selected to best accommodate the subjects (Montoye and Faulkner, 1964); it was not changed for any subject during either treatment.

Procedures:

All thirty subjects participated in each of two treatments allowing each subject to serve as his own control. The subjects were instructed to hold the dynamometer in a prescribed manner, designed to make each contraction consistent and to keep the subject from knowing the strength of each contraction. The subjects were given three practice trials before each treatment so that they could become familiar with the dynamometer. All contractions were made with the hand
each subject considered to be his dominant hand. In order to avoid the possibility of fatigue, a rest period of one minute between each trial was given each subject. All grip contractions were recorded to the nearest half kilogram.

During the control treatment many questions were presented to the experimenter by the subjects concerning the length of the task. The subjects were not given any information concerning the number of trials or the length of the task. In the control treatment each subject made ten grip contractions.

The only difference between the two treatments was that in the experimental treatment the subjects were casually told, prior to trials nine and ten, how many trials remained. Each subject participated in the experimental treatment approximately one month after they participated in the control treatment. All the subjects participated in this order so they would be less likely to exchange information about the task. It was also decided that alternating the conditions might induce the subjects to anticipate the information concerning the end of the task, if they had participated in the experimental treatment first.

Hypothesis to be Tested:

The purpose of this study was to determine whether the end-spurt phenomenon is a real phenomenon. A simple motor task was chosen and an experimental design formulated to
investigate whether the end-spurt phenomenon could be intentionally produced. Based upon suggestive evidence from prior research, it was predicted that in this study an end-spurt phenomenon could be intentionally produced.

**Data Analysis:**

The hypothesis was tested by the use of a "t" test of the difference between means for correlated data. The .05 level of significance was accepted as the criterion level for statistical significance. The analysis for determining mean differences was done in accordance with procedures given in Elsey (1973). Also, performance on early trials was correlated with performance on later trials by using Pearson Product Moment Correlation.2

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2Dr. Michael Clark in an interview with this author on July 5, 1974, at California State College, Bakersfield, was very helpful with the selection of these statistical procedures and their interpretation.
SECTION IV

RESULTS

Table 1 includes the mean values for each trial in the control and experimental treatments. These values are represented by the graph in Figure 1. In Figure 1 the broken line indicates the means for each trial in treatment (1) or the control group. The solid line indicates the means for treatment (2) or the experimental group.

TABLE 1
CONTROL AND EXPERIMENTAL MEAN SCORES FOR EACH TRIAL

<table>
<thead>
<tr>
<th>Trials</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control mean scores (kgs.)</td>
<td>51.0</td>
<td>49.8</td>
<td>50.0</td>
<td>49.2</td>
<td>49.3</td>
<td>48.9</td>
<td>48.6</td>
<td>48.9</td>
<td>48.0</td>
<td>48.3</td>
</tr>
<tr>
<td>Experimental mean scores (kgs.)</td>
<td>49.7</td>
<td>49.5</td>
<td>49.0</td>
<td>48.5</td>
<td>48.5</td>
<td>49.1</td>
<td>48.7</td>
<td>49.2</td>
<td>50.0</td>
<td>49.9</td>
</tr>
</tbody>
</table>
Figure 1 illustrates a pronounced primacy effect on the control group and only a slight primacy effect on the experimental group. This primacy effect is a phenomenon that often confronts researchers and it is thought that it is a result of the subject's fresh mental set for the task. This may be explained by the fact that the task was only new to the subjects in treatment (1). Trials six, seven and eight are especially interesting because they indicate that the subjects'
motivational level in the experimental situation was at least equal to the level maintained in the control situation. More importantly, trials nine and ten in Figure 1 demonstrate a decrease in performance in the control group, while the experimental group's performance in trials nine and ten increases. This disordinal interaction between the control and experimental groups, shown in Figure 1, supports the hypothesized end-spurt phenomenon.

In Table 2 a "t" test was used on the differences found to determine how the last two trials compared with the previous trials on both groups.

| TABLE 2 |
| SUMMARY OF t TEST DATA ON DIFFERENCES OF INITIAL AND FINAL PERFORMANCES FOR CONTROL AND EXPERIMENTAL GROUPS |
| Trials (1-8) | Trials (9-10) | Difference (9-10) - (1-8) |
| Control mean scores (kgs.) | 49.3 | 48.2 | -1.1 |
| Experimental mean scores (kgs.) | 48.8 | 50.0 | 1.2 |
| t = 4.50 which is significant (p< .05) (29 d.f.) |

The significant "t" found indicates there is a statistically significant difference between the experimental and control
groups when comparing performance on the last two trials to performance on the first eight trials.

In Table 3 correlations were computed on initial trials (trials one through eight) and final performance (trials nine and ten) for both control and experimental groups.

**TABLE 3**

**CORRELATIONS OF INITIAL WITH FINAL PERFORMANCE FOR CONTROL AND EXPERIMENTAL GROUPS**

<table>
<thead>
<tr>
<th>Group</th>
<th>Correlation (r)</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>.95</td>
<td>Significant (p &lt; .05)</td>
</tr>
<tr>
<td>Experimental</td>
<td>.34</td>
<td>Not significant (p &gt; .05)</td>
</tr>
</tbody>
</table>

Table 3 indicates a large relationship between initial and final performance in the control group and a small (not significant at p > .05 level) relationship in the experimental group.

These correlations lend further support for a significant end-spurt in the experimental group. The inconsistency of performance in this group clearly demonstrates differences in initial and final performance. This finding can only be attributed to the end-spurt phenomenon found in the experimental condition.
SECTION V

CONCLUSIONS

The disordinal interaction between the control and experimental groups illustrated in Figure 1, the significant "t" found in Table 2 and the correlations found in Table 3 indicate that end-spurt is a real phenomenon that can be produced intentionally. An end-spurt was created by using a simple motor task (grip strength) and manipulating the information variable. In the control situation no information concerning the proximity of the end of the task was given. In the experimental situation subjects were given this information and an end-spurt occurred. These results clearly support the hypothesis tested in this study.

End-spurt is a real phenomenon that can be produced intentionally. This information made available to physical educators and coaches will supply them with one way to improve motor performance. A coach who fails to notify each player when a task is nearly completed will probably not elicit the maximum performance level possible. There are no magic formulae for improving motor performance, but research that can identify a procedure that will improve performance is valuable. In sport there are many common practices that are thought to improve performance, but many common practices are
not based on scientific evidence. Motor performance and educators concerned with motor performance suffer from this lack of scientific data. Part of the significance of this research is that something more is known about end-spurt that is based on scientific evidence.

Studies that attempt to identify the factors that facilitate motor performance are crucial if physical educators are sincerely interested in improving motor performance. Some questions that this research has suggested to this author seem worth investigating. For example, can the increased level of performance associated with end-spurt be applied throughout the task? Can we identify the factors in the mental set that lead to an increased intent to respond? How long does the task have to be before we can illicit end-spurt? What is the relationship between pacing and end-spurt?

Not enough is known about what will illicit improved motor performance; end-spurt is just one factor in this consideration. More research is required in this area because this type of information is needed to improve motor performance.
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A. BOOKS


B. PERIODICALS


C. INTERVIEWS
