AN INVESTIGATION OF THE EFFECTS OF SHAM FEEDING ON MOTOR ENDURANCE

Thesis for the Degree of M. A.

MICHIGAN STATE COLLEGE

Edward Berman

1952

This is to certify that the

thesis entitled

An Investigation of the Effects of
Sham Feeding on Motor Endurance

presented by

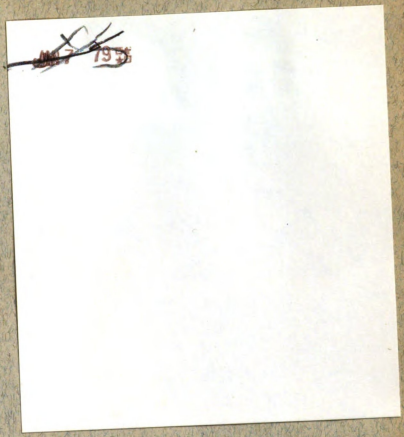
Edward Berman

has been accepted towards fulfillment
of the requirements for

M.A. degree in Physical Education

Henry J. Montoye
Major professor

Date March 6, 1953



AN INVESTIGATION OF THE EFFECTS OF SHAM FEEDING ON MOTOR ENDURANCE

by

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A THESIS

Submitted to the School of Graduate Studies of Michigan State College of Agriculture and Applied Science in partial fulfillment of the requirements for the degree of

MASTER OF ARTS

Department of Physical Education

1952

ACKNOWLEDGEMENT

I wish to express my gratitude to Dr. Henry J. Montoye for his help and guidance in this study.

E. B.

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CHAPTER I

THE PROBLEM

Introduction. It is a popular opinion that a person taking a capsule containing vitamins, phosphates, or certain other dietary supplements will perform above his normal capacity. This improvement may be due to the actual beneficial effects of the contents or to its supposed beneficial effects. It is commonly believed that a psychological effect caused by merely taking a placebo will improve motor performance.

Statement of the problem. The problem is to determine if sham feeding will delay the onset of fatigue in a motor endurance test.

Importance of the study. Many athletic coaches feel that capsule feeding does produce a beneficial effect in the respect of increasing motor output. Whether the capsules contain anything beneficial, or the increased motor performance is caused psychologically is of little importance to coaches. Since improvement is their only interest, no records have been kept in regard to a psychological effect increasing motor performance.

In several other dietary studies reference is made as to the possibility of a psychological factor distorting the results. In

many of these studies a placebo was used to account for the effect. However, the importance of this factor has never been determined. This study will aid in determining to what extent measures should be taken in future dietary experiments to limit this factor.

Sources of data. Fifty-six boys enrolled in a physical education service class at Michigan State College were given a motor performance test. These subjects were all selected from the same service class so that the conditioning benefits derived from Physical Education by them would all be as similar as possible. Furthermore, the testing period was toward the end of the term, and it was unlikely that their physical condition would change within the two week testing period after participating in strenuous physical activity for eight weeks.

The measure of motor performance was an endurance test on a bicycle ergometer that each subject rode at 20 m.p.h. with four pounds resistance.

Method of collecting data. The subjects were tested on the bicycle ergometer at the specified speed and friction, and the times were carefully recorded. These scores were ranked and divided into two equal groups. The subjects were tested again two weeks later so that any conditioning to the machine might be kept at a minimum. This second test was administered to each individual on the same day and approximately at the same time as his first test was taken. It is believed that the time of day influences performance and that

such means would tend to eliminate some of the extraneous variance.

One group received a capsule containing corn starch and was instructed that it was a vitamin pill that would probably increase their performance on the bicycle ergometer. The other group served as a control and received nothing. In order to avoid bias the investigator did not know which individuals had taken the capsules. All the subjects were instructed on both tests to extend themselves to their physiological limits.

Limitations. On an endurance test of this type there are many factors that might influence the performance of each individual. The room, atmosphere, and experimental procedure were kept the same in both tests.

1. Weather, diet, sleep, and studies were sources of interference that could not be regulated. It is impossible to make allowances for the unpredictable changes in an individual that cause him to excel one day and fail on another.

2. The age group involved might have been a limiting factor.

3. Non-athletes were used as subjects and the results might not be applicable to athletics.

4. Any psychological effect, because of individual differences, might cause an increase in performance in some individuals and a decrease in others.

CHAPTER II

REVIEW OF THE LITERATURE

In reviewing the literature it was found that the term "psychological effect" was mentioned in several studies concerning various drugs, dietary supplements, and other ergogenic aids. In most of these studies the mention of this factor was merely incidental. Typical of this type of reference is the study by Staton[1] in which he used commercial yellow corn meal as a placebo to offset the psychological effect. He recognized the possibility of a psychological effect influencing strength test performance during the lecithin feeding period.

Karpovich[2] reviewed several studies on ergogenic aids and stated, "Sham tests in which, instead of the 'real stuff,' inert substances are given should be employed, and the psychological factor should be controlled as much as possible." In his review he suspected that many conclusions were derived from faulty investigations in which no measures were taken to account for the psychological factor. He cited a study on fruit juices that was reported to increase the speed of swimmers. Since experimental evidence has shown that fruit juices are not directly connected with muscular performance,

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[1]Wesley M. Staton, "The Influence of Soya Lecithin on Muscular Strength," Research Quarterly, 22:201, May, 1951.

[2]Peter V. Karpovich, "Ergogenic Aids in Work and Sports," Research Quarterly Supp., 12:432, May, 1941.

he suspected a psychological effect.[3]

The classic experiment of Brown-Sequard in which he thought he was injecting himself with sex hormones also falls into this class of faulty conclusions. It is the concensus that Brown-Sequard's supposed physical and mental improvements were entirely due to a psychological effect.[4,5]

Karpovich[6] reemphasized the possibility of a psychological effect by citing an experiment by Marbe. Marbe's placebo, a drop of congo red in distilled water, produced the same effect as three to five grams of recresal.

It should be pointed out that no one has measured the psychological effect in endurance work.

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3 Ibid., p. 440.

4 Ibid., p. 440.

5 C. Donnell Turner, General Endocrinology, (Philadelphia: W. B. Saunders Company, 1949), pp. 6-7.

6 Peter V. Karpovich, op. cit., p. 444.

CHAPTER III

METHOD OF PROCEDURE

MATERIALS USED

The measure of motor performance was an endurance test on a frictional bicycle ergometer. Using Karpovich's[1] description as a model, a similar ergometer was constructed for The Michigan State College Physical Education Department. Friction was developed by a flywheel rubbing on a length of automobile brake band. The upper end of this band was connected to a commercial spring scale which was graduated into pounds and single ounce divisions. The lower end of the brake band was connected to suspended weights. When a subject pedalled the bicycle, the flywheel against the brake band lifted and partially supported the suspended weights. The reading on the scale was reduced equal to the amount of friction. Thus the difference between the suspended weights and the scale reading was the friction or work load.

In this study five pounds were suspended from the lower end of the brake band and the scale reading, while riding at twenty miles per hour, was one pound; thus, four pounds was the work load.

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[1] Peter V. Karpovich, "A Frictional Bicycle Ergometer," Research Quarterly, 21:210-215, October, 1950.

Occasionally, after continued use of the instrument, the scale reading would increase several ounces. This meant that the friction had decreased this amount. To bring the load back to the standard four pounds the same number of one ounce weights were added.

Mounted on the bicycle was a speedometer and a revolution counter. The speedometer was necessary to enable the subjects to pedal at the required twenty miles per hour. The revolution counter was covered so that the subjects would not know how well they were progressing.

One addition to the ergometer used in this study was a sweat guard preventing drops of perspiration from falling on the flywheel and causing disturbances in its function.

A stop watch was employed as the measure of duration of work rather than the revolution counter. The watch was started as soon as the subject reached twenty miles per hour and stopped when he could no longer maintain the pace. The revolution counter recorded the number of turns it took each subject to attain the required speed and also the number of turns made in coming to a stop. Since this number of revolutions was not constant, the revolution counter tended to record erroneous results of work done at twenty miles per hour.

Capsules were used so that the subjects could not taste the supposed energy substance. This allowed the use of corn starch. At first it was hoped that the capsules would hold their contents in tact long enough so that the entire experiment would be finished before the contents could be exposed in the gastro-intestinal tract. However, according to the manufacturer, the capsules were dissolved

partially within five minutes and a portion of the contents was exposed to the action of the body fluids. Since the subjects who received the capsules were finished within ten minutes after taking the capsules, it is assumed that there was no physical benefits derived from them.

It is very unlikely that corn starch can be broken down, absorbed, and transported to muscle tissue within five minutes. Furthermore, each capsule contained less than one gram of starch. Since corn starch yields 362 calories per hundred grams, the number of calories that could possibly be derived from each capsule was less than five.[2] This figure seemed inconsequential in the light of the fact that several thousand calories are used in daily activity.

It should also be pointed out that no other beneficial effects are likely to be derived from this amount of corn starch.

TESTING PROCEDURE

Fifty six male freshmen and sophomore students enrolled in the same physical education service class were tested on the bicycle ergometer at twenty miles per hour with four pounds resistance. After this first test two subjects were dropped from the experiment. One had been sick in the hospital and was below his normal condition. His improvement in the second test would be due chiefly to his improved

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2 Agriculture Handbook No. 8, "Composition of Foods," U.S. Department of Agriculture, June, 1950, pp. 46-47.

physical condition. The other subject was dropped because of his lack of interest and attitude. It appeared quite obvious that he did not extend himself to his physiological limit.

The scores of this test were tabulated and ranked as shown in Table I. From these rankings two equal groups were arranged in Table II. The arrangement was made in such a manner that if a subject in one group failed to take the second test the nearest score to him in the other group could be dropped to keep the groups equal.

Two weeks later to the day each individual rode the bicycle ergometer at the same speed and weight as on the first trial. On this test one group, called the experimental group, received a capsule containing corn starch. The other group, the control, received nothing. Each subject reported at his appointed time to one of the laboratory rooms next to the room containing the bicycle. An assistant there gave the experimental subject his capsule, and informed him that the capsule would in all probability enable him to ride the bicycle for a longer period of time.

The investigator did not know whether the subjects belonged in the control or the experimental group at the time of the second test; and the subjects were instructed not to inform him until after the results had been recorded. After a brief warm-up period of fifty slow revolutions, which also preceded the first trial, each subject was again urged to extend himself to his physiological limit. The whole procedure, from the time a capsule was taken until the ride was finished, was less than ten minutes.

TABLE I

RANKING THE TIMES OF THE FIRST TRIAL

Rank	Time (Min., sec., and tenths)	Rank	Time (Min., sec., and tenths)
1	44.9	28	1:41.6
2	50.5	29	1:42.0
3	55.4	30	1:42.3
4	56.5	31	1:49.9
5	1:09.5	32	1:51.7
6	1:10.5	33	1:52.0
7	1:13.0	34	1:52.4
8	1:13.8	35	1:53.8
9	1:14.1	36	1:58.0
10	1:15.4	37	2:02.4
11	1:17.4	38	2:08.5
12	1:17.4	39	2:09.0
13	1:18.8	40	2:09.5
14	1:19.0	41	2:12.1
15	1:22.5	42	2:12.7
16	1:23.2	43	2:18.6
17	1:26.5	44	2:21.1
18	1:28.1	45	2:22.8
19	1:30.0	46	2:25.5
20	1:31.0	47	2:33.2
21	1:31.5	48	2:44.7
22	1:31.8	49	2:46.6
23	1:32.8	50	2:50.4
24	1:35.0	51	3:07.3
25	1:35.5	52	3:25.9
26	1:37.6	53	3:37.7
27	1:38.0	54	5:06.6

TABLE II

METHOD OF EQUATING GROUPS

Group I	Group II
1	2
4	3
5	6
8	7
9	10
12	11
13	14
16	15
17	18
20	19
21	22
24	23
25	26
28	27
29	30
32	31
33	34
36	35
37	38
40	39
41	42
44	43
45	46
48	47
49	50
52	51
53	54

Two subjects failed to take the second run on the bicycle. They were ranked eleventh and fourteenth, and were in the same group. Rankings twelve and thirteen in the other group were also dropped so that the groups would remain equal. This brought the number of subjects down to fifty who completed the whole experiment.

STATISTICAL METHOD

The data derived from this investigation were subjected to the following statistical treatment:

1. The coefficient of correlation between the scores of the control group in both tests was calculated.

2. The coefficient of correlation was also calculated for the scores of the experimental group in the first and the second tests.

3. In order to check the statistical significance of the differences in achievement shown by each group in both tests the large sample "t" values were calculated between the scores of the first and second tests of the experimental group, and the scores of the first and second tests of the control group.

4. A small sample "t" was also calculated using the differences in the scores of the first and second tests of the control group, and comparing them to the differences in the scores of the experimental group.

These data and calculations are included in Chapter IV.

CHAPTER IV

RESULTS

The results are presented in tabular form on page 14, and are also represented graphically in Figure 1 on page 15.

The coefficient of correlation between the first and second tests of the control group was .959. This correlation indicates high reliability of the bicycle ergometer and the consistency of the control group. It was thought advisable to correlate these tests excluding the twenty fifth subject who scored unusually high on both trials. It was felt that this subject's scores could possibly influence the correlation unduly. Without his scores the coefficient of reliability dropped from .959 to .901 which is still high for this kind of measurement.

The coefficient of correlation between the first and second tests of the experimental group was only .743. The reason for the experimental group correlation being lower than that of the control group may be explained by the variable, the placebo. The placebo probably influenced some of the experimental group to either improve or lower their scores in the second test. These changes, however, were not great enough to show up in the "t" scores. (See Table III) These coefficients were converted to Fisher "z" scores and the significance of their difference in magnitude was calculated. The "t" value was 4.3 which was significant at the .001 level.

TABLE III

DESCRIPTIVE STATISTICS AND SIGNIFICANCE RATIOS IN THE COMPARISON OF ERGOMETER TIMES FOR THE CONTROL AND EXPERIMENTAL GROUPS

	Mean (sec.)	SD	N	Range	Signif. Ratio	P
Control (first test)	115.83	51.3	25	50.5-306.6	.743	.227
Control (second test)	118.50	53.9	25	60.0-350.4		
Experimental (first test)	113.18	41.8	25	44.9-217.7	1.090	.138
Experimental (second test)	119.83	41.6	25	44.6-195.1		

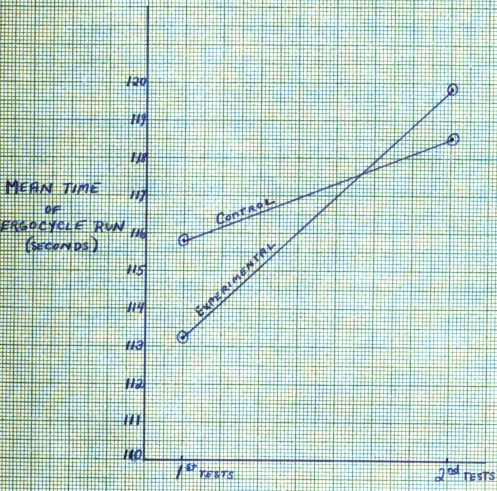

FIGURE 1

THE EFFECTS OF SHAM FEEDING
ON A MOTOR ENDURANCE TEST
(N = 25 in each group)

A large sample "t" value was calculated for the control and experimental groups on the first test. The coefficient of correlation was .943; the "t" value was .710; and the probability was .239. This showed that the groups were fairly equal and any differences between the two groups at the start were insignificant.

Both the large sample "t" and the student's "t" values were calculated because the number of cases seemed to be on the borderline as far as rules governing the use of the statistics. The student's "t" was calculated by using the differences in the scores of the first and second trials of each group. Its value was .552 which was also insignificant at both the 1% and 5% levels which were 2.797 and 2.064 respectively.

CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

SUMMARY

The purpose of this investigation was to determine if sham feeding would produce a psychological effect that would delay the onset of fatigue in a motor endurance test. Fifty college freshmen and sophomores were pretested on a bicycle ergometer and arranged in two equal groups according to their scores. One group received a capsule containing corn starch and was instructed it was a "quick energy pill." The other group served as a control and received nothing. Both groups were again tested on the bicycle ergometer at twenty miles per hour and against four pounds resistance load.

All the subjects were selected from the same service class so that conditioning would not be a disturbing factor. Each subject was tested the second time two weeks after his first test and at the same time of day.

The results were statistically analyzed and large "t" and students "t" were calculated.

CONCLUSIONS

On the basis of the data derived from this investigation the following conclusions are set forth:

1. No significant differences were demonstrated in the improvements in motor endurance of the experimental group over the control group.

2. Since the mean of the experimental group started lower and ended higher than the means of the control group, a trend was indicated that sham feeding does increase motor endurance.

3. The differences in correlations between the first and second trials of each group further indicated that some additional factor, presumably a psychological factor, was present in the experimental group but not in the control.

4. The reliability of the frictional bicycle ergometer used in this study was proven to be quite high.

RECOMMENDATIONS

The following recommendations are made for additional investigation into the effects of sham feeding:

1. This experiment should be repeated using athletes, former athletes, or physical education majors for subjects.

2. It is recommended that a similar experiment be set up using a placebo that would appeal to the sense of taste.

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APPENDIX

BASIC DATA FOR EXPERIMENTAL GROUP

Subject	Time of First Run	Time of Second Run	Difference in Scores
Jeffery	44.9	44.6	-.3
Wright	56.5	83.1	+26.6
Crowe	69.5	54.4	-15.1
Coon	73.8	80.4	+6.6
Irish	74.1	85.6	+11.5
Chambers	83.2	91.3	+8.1
Barnes	86.5	108.5	+22.0
Terpeny	91.0	89.4	-1.6
Wintermute	91.5	74.3	-17.2
Johnson	95.0	133.2	+38.2
Houdek	95.5	127.7	+32.2
Hinesley	101.6	109.8	+8.2
Harris	102.0	99.4	-2.6
Zick	111.7	182.9	+71.2
Govan	112.0	97.6	-14.4
Hoffman	118.0	113.9	-4.1
Bertram	122.4	127.2	+4.8
Dutcher	129.5	162.2	+32.7
Pope	132.1	174.5	+42.4
White	141.1	175.0	+33.9
Haight	142.8	149.9	+7.1
Summers	164.7	192.0	+27.3
Oleson	166.6	105.8	-60.8
Gowan	205.9	138.0	-67.9
Chapman	217.7	195.1	-22.6

BASIC DATA FOR CONTROL GROUP

Subject	Time of First Run	Time of Second Run	Difference in Scores
Karamazrak	50.5	60.0	+9.5
Content	55.4	71.5	+16.1
Sheffey	70.5	69.0	-1.5
Church	73.0	68.7	-4.3
Touhey	75.4	107.4	+32.0
Roberts	82.5	67.7	-14.8
Pyman	88.1	89.4	+1.3
McClurg	90.0	104.2	+14.2
Hawley	91.8	82.1	-9.7
Stratton	92.8	81.4	-11.4
Segura	97.6	103.3	+5.7
Warwich	98.0	99.4	+1.4
Hemingway	102.3	118.3	+16.0
Hamilton	109.9	97.8	-12.1
Anderson	112.4	115.3	+2.9
Dawsey	113.8	101.5	-12.3
Smith	128.5	113.3	-15.2
Chapid	129.0	107.0	-22.0
Sprott	132.7	122.3	-10.4
Beardsley	138.6	125.3	-13.3
Pearce	145.5	167.3	+21.8
Swick	153.2	174.6	+21.4
Whitehead	170.4	198.9	+28.5
Walker	187.3	166.3	-21.0
McDonald	306.6	350.4	+43.8

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