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The relationship between reaction-time and general motor ability test for girls.

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BOSTON UNIVERSITY
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Thesis

THE RELATIONSHIP BETWEEN REACTION-TIME AND GENERAL
MOTOR ABILITY TEST FOR GIRLS

Submitted by
Virginia M. Gardner
(B. S. University of New Hampshire 1943)

In partial fulfillment of requirements for the
degree of Master of Education

1952

Boston University
School of Education
Library

First Reader:

James A. Wylie
Professor of Education

Second Reader:

Arthur G. Miller
Associate Professor of Education

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CHAPTER I
INTRODUCTION

Statement of the problem: This is a study to determine the correlation of the individual's reaction time as measured by the Stoelting Visual Reaction Timer and the individual's General Motor Ability as measured by Scott and French.

Scope of the problem: Fifty high school girls were selected at random from a group that reported for interscholastic softball at the beginning of the season at Malden High School.

These girls were tested at Boston University for simple reaction time by the Stoelting Visual Reaction Timer. They were given the General Motor Ability test devised by Scott and French at the Malden High School Gymnasium.

Justification of the problem: Very little has been done in the field of Physical Education and Recreation in experiments with innate capacities such as reaction time. Every experienced teacher knows that some students learn much more rapidly and with less apparent effort than others. Some children are awkward and clumsy in even the simplest coordinations while others imitate successfully motor performance of a complex type. This is both a problem and a challenge to the thoughtful teacher. This study is being made to see if reaction time may be a determining factor in motor ability.

CHAPTER II

Review of the Literature

In the field of Physical Education and Recreation there is little literature dealing with experiments in innate capacities. However, in the field of experimental psychology there is a wealth of material.

One definition of reaction time is: "The interval between the stimulus and the response is known as the reaction time. Reaction time is due in part to the inertia of the nervous system and in part to the time which it takes for a nervous impulse to pass from one part of the system to another."1/

According to studies made by Ruch reaction time is not the same for all sense organs.2/ Pain has the slowest reaction time of .400 second while tactual is the fastest with .115 second. Visual was .150 second. Visual reaction time is being used in this study.

1/ Coleman Griffith, Psychology and Athletics, New York, Charles Scribner & Sons, 1928, Chapter 9.

2/ Floyd L. Ruch, Psychology and Life, New York, Scott, Foresman & Company, 1941.

Studies made by Cattell 1/ indicate that the length of reaction time is not greatly affected by: the conditions of the observer, the time of day, the number of reactions already made, nor the amount of practice. Reaction time is longer for light than for sound and touch.

Studies by Biertweiser indicate that certain external factors do affect reaction time. Some of these factors are: difference in the quality and intensity of the stimulus, different resistance offered by the keys with which the subject reacted, position of the body during the reaction, mode and extent of movement called for by the reaction. Such subjective factors as fatigue, temperament and habit must also be taken into consideration.2/

Bills 3/ indicates that there are certain general factors which influence the length of reaction time. The more important being: Practice, which shortens the time, fatigue which lengthens it, and the time elapsing between ready signal and stimulation.

1/ Cattell, J. M. and Charles S. Dolley: "On Reaction Times and Velocity of the Nervous Impulse," Memoirs of the National Academy of Science, Vol. VII, Government Printing Office, Washington, D. D., 1895.

2/ Biertweiser, J. V. "Attention and Movement in Reaction Time" Archives of Psychology 18:1911

3/ Bills, A. Gilbert, General Experimental Psychology, Longmoss, Green & Co., New York, 1934.

Following are some other conclusions derived in the field of reaction time.

Atwell showed an improvement in reaction time with increasing age except at the fifteen year level in his study of high school boys.^{1/}

Elbel ^{2/} experimented in simple reaction time as a function of the time of day. He found there were differences during different periods of the day. The slowest periods were early and late in the morning and there were two periods of greatest speed, one in the morning, the other in the afternoon.

In studies made by Poffenberger it was discovered that there was a difference in reaction time between the left and the right hand. He also showed that reaction time has no great increase in practice aside from the general increase due to a growing familiarity with the situation.^{3/}

There are two major types of reaction times, those which involve simple responses and those which involve complex or discriminatory responses. The discriminatory reaction time involves a choice while the simple reaction time does not. The more simple the stimuli the faster the reaction will be. This study will deal only with the simple reaction time.

^{1/} Atwell, W. D. & Elbel, E. R. "Reaction Time in Male High School Students in the 14-17 age group" Research Quarterly 19:22-29, 1948

^{2/} Elbel, E. R. "Study in Variation in Response Time", Research Quarterly, Vol. 10, March 1939, P.P. 35-58.

^{3/} Poffenberger, A. T. Jr., "Reaction Time to Retinal Stimulations" Archives of Psychology, 23:1912

One of the factors which influence reaction time is the elapsing between the ready signal and the stimulation. This is the fore period.^{1/} If it is always the same length the subject is apt to react to the signal and not to the stimulus. This can be avoided by using a random variation of the length of the foreperiod before each stimulus. The intervals must not be too short or too long as one will find the subject unprepared and the other will decrease his readiness.

Woodworth has stated that the foreperiod should not be shorter than one-half second nor longer than four seconds.^{2/}

There has been some experimenting in the field of Physical Education, Health, and Recreation and "reaction time". Most of this has been concerning the relationship of reaction time and abilities in specific sport skills.

Keller found that there is a positive relationship between the ability to move the body quickly and success in athletic ability.^{3/}

^{1/} American Association for Health, Physical Education and Recreation, Research Methods Applied to Health, Physical Education and Recreation, Washington, D. C.: Department of the National Education Association, 1949.

^{2/} Woodworth, R. S., Experimental Psychology, New York, Holt and Company, 1938

^{3/} Keller, Louise F. "The Relation of Quickness of Body Movement to Success in Athletics", Research Quarterly, May 1942.

Studies made by Burpee and Stroll 1/ indicated a significant negative relationship between small-muscle reaction time and successful participation in physical education activities. There appeared to be a large negative correlation between large-muscle reaction time as tested, and successful participation in these activities.

At present, from what experiments have been done, it would seem there is a positive correlation between reaction time and efficiency in athletic skills.

There is a great need for further experimentation in this field for as yet we have not discovered the net value of a person with fast reaction time.

1/ Burpee, Royal H. and Wellington Stroll, "Measuring Reaction Time of Athletics", Research Quarterly, Vol. 8, March 1936 p.p. 110-118.

CHAPTER III
TECHNIQUES AND PROCEDURES

Procedures:

The subjects used for this test were seventy high school girls from Malden, Mass. who reported for varsity softball. There were only fifty who actually finished the tests. The others dropped out for various reasons such as jobs, leaving school and loss of interest.

The next procedure was to find a General Motor Ability Test for girls. The test finally chosen was the one set up by Scott and French.^{1/} There were four items in this test: Wall Pass, Standing Broad Jump, Basketball Throw for Distance, and the Dash (4 seconds)

These tests were given in the gymnasium at Malden High School and the author gave all the tests personally.

1. The Wall Pass Test

The subject stood with her toes behind a line which was nine feet from the wall. The basketball was thrown against the wall, caught, and repeated again as quickly as possible. The throw may be of any type. The subject had to stay behind

^{1/} Scott, Gladys and French, Esther, Evaluation in Physical Education, C. V. Mosby Co. 1950.

the line at all times. The score was the number of hits on the wall. The time allowed was fifteen seconds. Each person was allowed three or four practice throws before taking the test. Only one trial was given.

2. Basketball Throw for Distance

The subject stood anywhere she pleased behind the throwing line but could not step on or across the line when throwing.

The space was eighty feet long and twenty feet wide. A throwing line was marked eight feet from one end of the course and parallel lines every five feet beginning fifteen feet in front of the throwing line. The subject could throw the ball in any manner she wished (overhand, underhand, stationary position, or with a step or run). She threw the ball three consecutive times. The score was the distance from the throwing line to the spot where the ball touched the floor. Only the longest throw out of the three counted.

3. Standing Broad Jump

This test was given inside using a mat eight feet long. A beat board placed against the wall was used for a take off board. The mat was marked in two inch intervals. The subject stood on the take-off board and had to take off with both feet simultaneously jumping as far forward on the mat as possible. The score was the distance from the edge of the take-off board to the nearest heel. The best of three trials was counted.

4. The Dash (4 seconds)

A straight course was laid out in the gym 90 feet long

and 4 feet wide. The course was marked out in 1 yard zones beginning 10 yards from the starting line to 27 yards from the end line. The subject started in any position she wished with toes behind the starting line. On the signal, "Ready Go"!, she started running as fast as possible and kept going until the whistle blew. The score was the distance she had run between the starting signal and the whistle.

Scoring Technique:

The results of the tests were changed into T-scores by using the chart set up by Scott and French. The General Motor Ability rating was obtained by averaging these four scores together.

Reaction-Time Test:

Instrument: Stoelting Visual Reaction Timer.

1. Consisted of a controlled cabinet
 - a. A timing clock or chronoscope which can be read to .003 second.
 - b. The controls were a three point selection switch key and a three position switch key for indicating color at the light source.
2. Reaction Key Board
 - a. Three telegraph type keys agree with the point selection switch key.
 - b. The reaction key board and light stimulus were fastened to a three quarter inch base to prevent movement and to standardize procedure.

3. Light Stimulus

a. Three colored lights each controlled individually by the three position visual switch.

4. Starting Board

a. Consisted of a four inch by thirteen inch board $\frac{3}{4}$ inch thick put there to raise the hand up to approximate level of the response keys. It also standardized the distance of subject's hand from the keys.

5. Plywood Shield

a. Shielded the controlled cabinet and operator's hands from subject's view.

Test:

1. Simple (one response to one stimulus)

a. Subject sat at the table which held key-board and light stimulus with hand resting on starting board and arm resting on table. The middle finger was placed on position marked "start" and the heel of the hand touched the starting board.

b. Subject was given 6 practice trials. On presentation of red stimulus the subject moved his hand forward a distance of $1\frac{1}{2}$ inches and depressed key number 2 directly in front of hand. This stopped the chronoscope and time lapses from the time light was stimulated and the time was recorded. The subject's hand returned to "starting" position after each response.

c. After the practice trials, which were not recorded, eleven reaction time trials were recorded for use in

this study.

d. The subject was given a ready signal by verbal command "ready". A fore period from 2 to 4 seconds followed the ready signal before stimulus was presented. A random variation of the length of the fore period was set up by the operator. The same order was used for each subject.

CHAPTER IV
TREATMENT AND ANALYSIS OF DATA

The data gathered for this study were treated as an entity rather than being divided into units peculiar to sophomore, junior and senior players.

The data was divided into six different items and each of the items was correlated with simple reaction time.

The items were:

General Motor Ability

The wall bounce test

The basketball throw for distance test

The standing broad jump test

The dash (four seconds) test

Simple reaction time

The correlations in this study have been computed by the use of the Correlation Chart developed by Lindquist.^{1/}

In the consideration of the level of significance to be used in order to call a finding significant, it was decided to follow the following suggestion:

^{1/} Lindquist, E. F. A First Course in Statistics, Houghton Mifflin Company, Boston, Mass., 1938.

"If some reader must have a criterion regarding what is or is not significant, the author suggests that he compromise by taking the level indicated by a P or .01 (or a CR of 2.58). One way out of the difficulty, so far as verbalization is concerned, is to say that a difference is significant at the .05, the .02, the .01, the .001, or whatever level it reaches".^{1/}

In estimating the significance ratio, it was noted that a special consideration had to be given to small samples. The use of t was decided upon for the following reasons:

1. The table used by McNemar^{2/} is set up with the degrees of freedom already worked out.
2. The ratio symbolized as t differs from CR in two important respects; "A refined estimate of the standard error is utilized, and the sampling distribution of t does not follow the normal curve."^{3/}
3. The computation of the t value requires the use of only one square root operation.

The formula used for the computation of t in the significance of correlation for small samples is

$$t = r \frac{N-2}{1-r^2} = \frac{r}{\frac{1-r^2}{N-2}}$$

The following tables show the scores of each individual for each item and the results of the various correlations:

^{1/} McNemar, Quinn, Psychological Statistics, John Wiley and Sons, Inc., New York, 1949, p. 69.

^{2/} Ibid, p. 352.

^{3/} Ibid, p. 216.

Raw Data - Table I

Simple Reaction Time Readings and Medians

Case Number	1	2	3	4	5	6	7	8	9	10	11	Median
1	.290	.315	.255	.355	.265	.305	.340	.275	.300	.330	.345	.305
2	.340	.355	.390	.365	.365	.360	.400	.350	.340	.350	.400	.360
3	.415	.360	.280	.350	.340	.320	.330	.450	.450	.325	.440	.350
4	.330	.330	.315	.350	.340	.370	.345	.315	.315	.375	.340	.340
5	.410	.390	.335	.325	.305	.385	.340	.335	.325	.410	.310	.335
6	.380	.380	.340	.300	.300	.280	.270	.270	.320	.320	.280	.300
7	.300	.310	.315	.270	.260	.260	.270	.265	.340	.310	.250	.270
8	.275	.365	.410	.350	.355	.345	.340	.390	.315	.345	.300	.345
9	.330	.390	.290	.295	.280	.265	.285	.300	.310	.270	.275	.290
10	.360	.390	.370	.330	.315	.320	.310	.335	.335	.335	.300	.335
11	.390	.350	.300	.400	.330	.380	.385	.360	.365	.350	.350	.350
12	.450	.450	.480	.350	.420	.410	.410	.360	.310	.340	.290	.410
13	.380	.500	.320	.385	.370	.370	.370	.315	.340	.300	.390	.370
14	.400	.340	.410	.400	.310	.340	.345	.310	.295	.320	.340	.340
15	.375	.365	.250	.410	.330	.335	.320	.320	.400	.300	.390	.335

Raw Data - Table I (Continued)

Simple Reaction Time Readings and Medians

Case Number	1	2	3	4	5	6	7	8	9	10	11	Median
16	.310	.370	.335	.350	.310	.315	.280	.330	.295	.370	.300	.315
17	.430	.390	.410	.430	.420	.380	.460	.395	.380	.360	.390	.390
18	.410	.350	.380	.350	.340	.345	.320	.320	.310	.330	.340	.340
19	.360	.315	.300	.400	.310	.280	.370	.365	.345	.345	.310	.345
20	.385	.460	.490	.450	.425	.460	.455	.450	.480	.380	.370	.450
21	.360	.390	.440	.360	.355	.380	.390	.315	.370	.325	.400	.370
22	.290	.270	.290	.290	.270	.285	.300	.270	.270	.250	.310	.285
23	.285	.355	.315	.360	.340	.330	.345	.330	.390	.385	.380	.345
24	.490	.500	.630	.520	.540	.440	.550	.540	.500	.510	.550	.520
25	.430	.440	.430	.390	.420	.495	.530	.400	.440	.430	.500	.430
26	.440	.440	.430	.400	.385	.375	.350	.420	.355	.410	.385	.400
27	.380	.360	.360	.400	.340	.340	.350	.315	.410	.350	.350	.350
28	.340	.340	.350	.360	.420	.345	.420	.300	.310	.305	.350	.345
29	.410	.430	.360	.410	.490	.470	.540	.470	.430	.440	.450	.440
30	.340	.330	.315	.300	.285	.380	.400	.370	.295	.350	.380	.340

Raw Data - Table I (Continued)

Simple Reaction Time Readings and Medians

Case Number	1	2	3	4	5	6	7	8	9	10	11	Median
31	.370	.370	.380	.345	.420	.370	.340	.345	.360	.370	.345	.370
32	.310	.320	.310	.310	.320	.350	.270	.240	.270	.340	.330	.310
33	.410	.395	.395	.350	.425	.385	.330	.340	.375	.410	.390	.390
34	.345	.375	.360	.470	.310	.310	.315	.400	.420	.285	.430	.360
35	.460	.350	.350	.280	.390	.350	.420	.420	.300	.440	.350	.350
36	.315	.360	.380	.370	.450	.390	.300	.430	.310	.295	.300	.360
37	.375	.395	.340	.340	.330	.305	.270	.340	.380	.310	.300	.340
38	.425	.325	.350	.415	.380	.385	.400	.400	.435	.430	.360	.400
39	.400	.300	.290	.330	.315	.290	.285	.360	.295	.390	.370	.315
40	.400	.420	.390	.420	.450	.490	.410	.415	.430	.400	.440	.420
41	.400	.390	.440	.425	.370	.320	.370	.370	.350	.470	.345	.370
42	.330	.315	.360	.350	.370	.400	.410	.415	.330	.345	.315	.350
43	.425	.550	.525	.525	.445	.490	.410	.480	.510	.470	.490	.490
44	.325	.390	.390	.400	.390	.420	.490	.465	.435	.490	.410	.410
45	.340	.370	.380	.380	.365	.330	.310	.340	.350	.330	.355	.350

Raw Data - Table I (Continued)

Simple Reaction Time Readings and Medians

Case Number	1	2	3	4	5	6	7	8	9	10	11	Median
46	.430	.420	.415	.350	.320	.370	.390	.410	.360	.370	.400	.390
47	.325	.380	.290	.295	.370	.260	.335	.315	.295	.300	.330	.315
48	.320	.370	.360	.370	.340	.315	.330	.400	.320	.340	.295	.340
49	.340	.450	.290	.260	.410	.240	.250	.240	.240	.340	.330	.290
50	.335	.445	.385	.495	.365	.510	.460	.456	.370	.400	.340	.445

Raw Data - Table II

T Scores for General Motor Ability Tests and General Motor Ability Score									
Case Number	Broad Jump		Wall Pass		Throw		Dash		General Motor Ability Score
	Inches	T Score	Number of Times	T Score	Distance Feet	T Score	Distance Feet	T Score	
1	89	70	15	77	61	72	23	60	70
2	76	57	13	69	74	80	25	68	69
3	84	64	13	69	66	76	24	64	69
4	84	64	14	73	56	70	24	64	68
5	84	64	13	69	51	67	25	68	67
6	88	70	12	63	47	63	23	60	64
7	86	68	11	58	44	59	26	71	64
8	80	61	12	63	51	61	24	64	64
9	80	61	11	58	57	71	23	60	63
10	80	61	11	58	55	70	23	60	62
11	78	59	14	73	51	67	20	45	61
12	86	68	12	63	49	50	23	60	60
13	64	45	16	80	50	66	30	45	59
14	86	68	9	46	41	56	24	64	59
15	78	59	12	63	37	51	25	68	59
16	66	47	12	63	56	70	21	56	58

Raw Data - Table II (Continued)

Case Number	T Scores for General Motor Ability Tests and General Motor Ability Score								
	Broad Jump		Wall Pass		Throw		Dash		General Motor Ability Score
	Inches	T Score	Number of Times	T Score	Distance Feet	T Score	Distance Feet	T Score	
17	76	57	13	69	34	47	22	55	57
18	84	64	11	58	44	59	21	49	58
19	66	47	10	52	45	60	24	64	56
20	84	64	8	41	44	59	23	60	56
21	60	41	12	63	36	50	25	68	56
22	55	37	12	63	36	50	22	55	55
23	76	57	12	63	36	50	21	50	55
24	62	43	10	52	42	57	23	66	55
25	68	48	11	58	41	56	23	60	55
26	68	48	9	46	50	66	23	60	55
27	80	61	9	46	48	64	21	50	55
28	72	52	9	46	37	51	25	68	54
29	70	49	11	58	36	50	22	55	53
30	68	48	10	52	41	56	22	55	53
31	70	49	10	52	43	58	21	50	52
32	68	48	10	52	35	49	22	55	51

Raw Data - Table II (Continued)

T Scores for General Motor Ability Tests and General Motor Ability Score									
Case Number	Broad Jump		Wall Pass		Throw		Dash		General Motor Ability Score
	Inches	T Score	Number of Times	T Score	Distance Feet	T Score	Distance Feet	T Score	
33	68	48	12	63	24	32	23	60	51
34	48	33	10	52	47	63	22	55	51
35	66	49	9	46	32	45	23	60	50
36	70	49	9	46	30	42	24	64	50
37	64	45	10	52	38	52	20	45	49
38	74	55	13	69	35	49	26	71	49
39	58	39	10	52	33	46	23	60	49
40	67	48	9	46	30	42	22	55	48
41	54	37	10	52	35	48	22	55	48
42	64	45	7	37	32	45	24	64	48
43	58	39	10	52	29	41	21	50	46
44	60	41	9	46	26	36	23	60	46
45	65	46	8	41	35	49	20	45	45
46	66	47	9	46	33	46	19	41	45
47	58	39	9	46	39	53	17	29	42
48	64	45	7	37	27	38	20	45	41

Raw Data - Table II (Continued)

T Scores for General Motor Ability Tests and General Motor Ability Score

Case Number	Broad Jump		Wall Pass		Throw		Dash		General Motor Ability Score
	Inches	T Score	Number of Times	T Score	Distance Feet	T Score	Distance Feet	T Score	
49	62	43	6	31	25	34	22	55	41
50	56	38	8	41	25	34	20	45	40

TABLE III

Correlation Between Simple Reaction Time and General Motor Ability for Girls

Simple Reaction Time	r	Standard Error	t	Level of Significance
General Motor Ability	.036	.127	.008	None

The correlation presented in Table III is very low and non-significant.

TABLE IV

Correlations Between Simple Reaction Time and Items in the
General Motor Ability Test for Girls

Simple Reaction Time	r	Standard Error	t	Level of Significance
Throw for Distance	.077	.110	.02	None
Wall Bounce Test	.105	.002	.25	None
Dash	.143	.138	.33	None
Broad Jump	.071	.142	.02	None

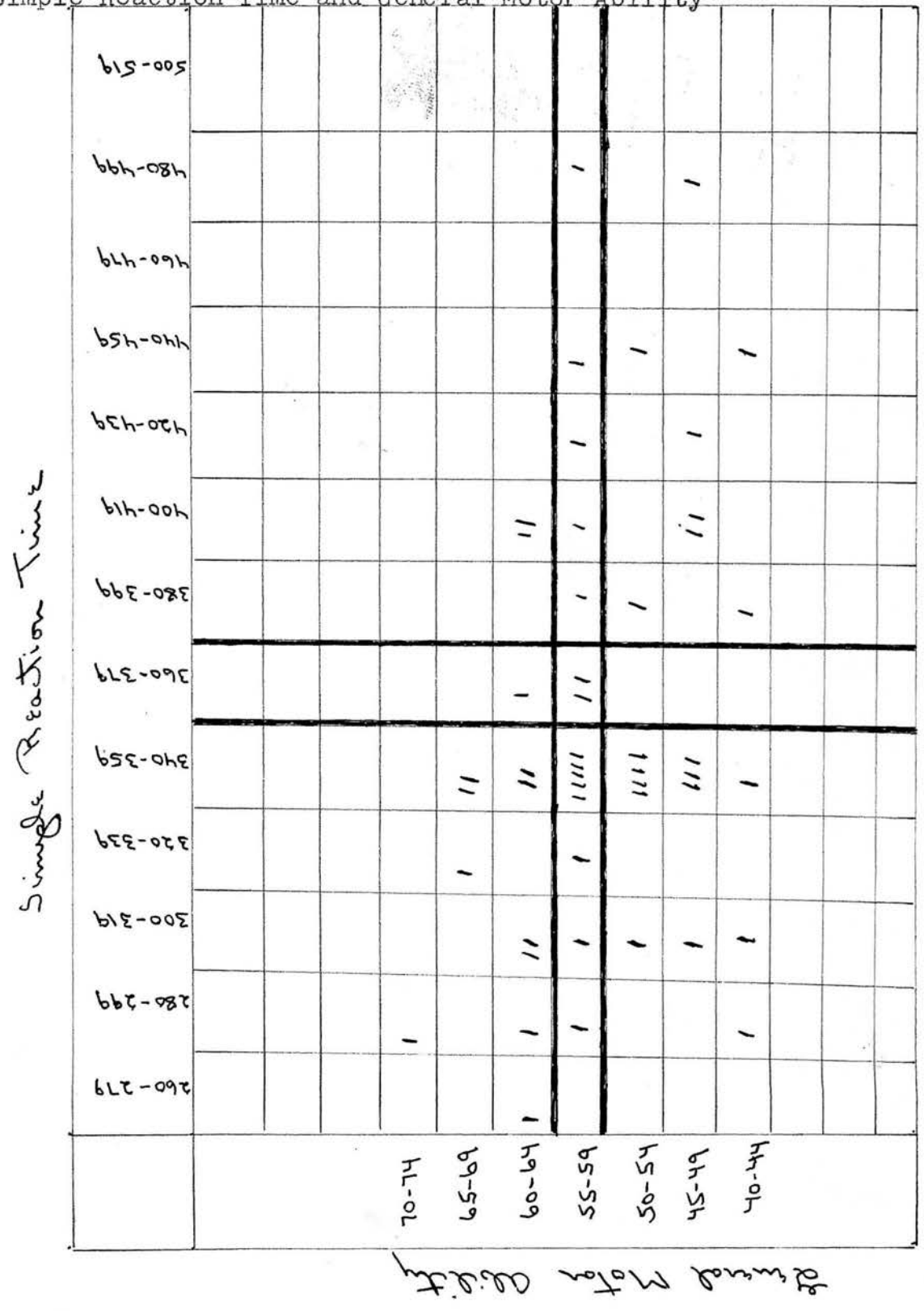
The data presented in Table IV shows a low and non-significant correlation between simple reaction time and basketball throw for distance. It shows a low and non-significant negative correlation between simple reaction time and the remaining three items.

Analysis of Data.--- Of the five correlations done in this study none were high or significant.

There was no significant correlation between the General Motor Ability Test for Girls and Simple Reaction Time.

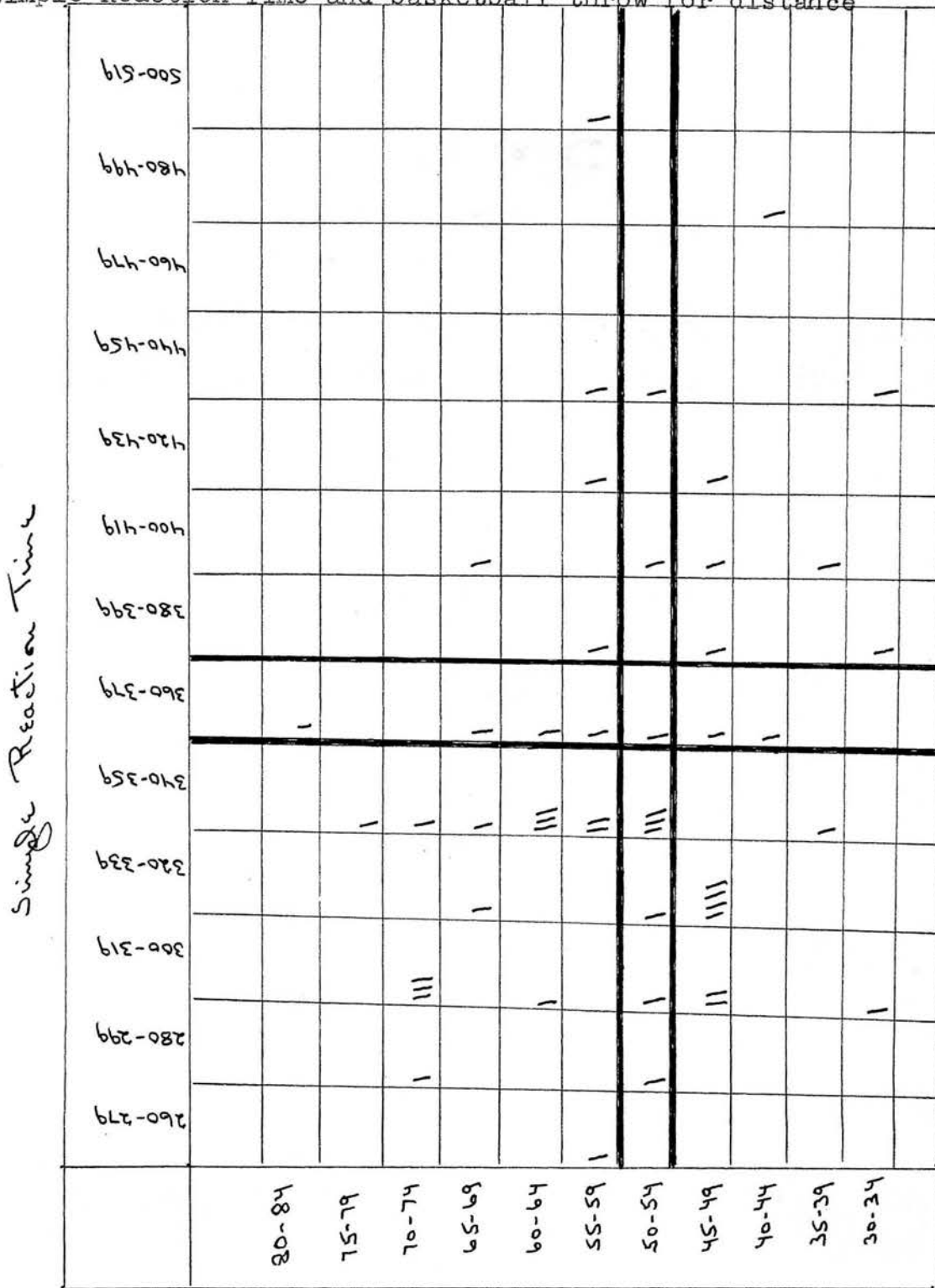
The highest correlation was between Simple Reaction Time and the Wall Bounce Test.

SCATTER DIAGRAM I
Simple Reaction Time and General Motor Ability



$r = -0.036$ $r^2 = 0.00127$

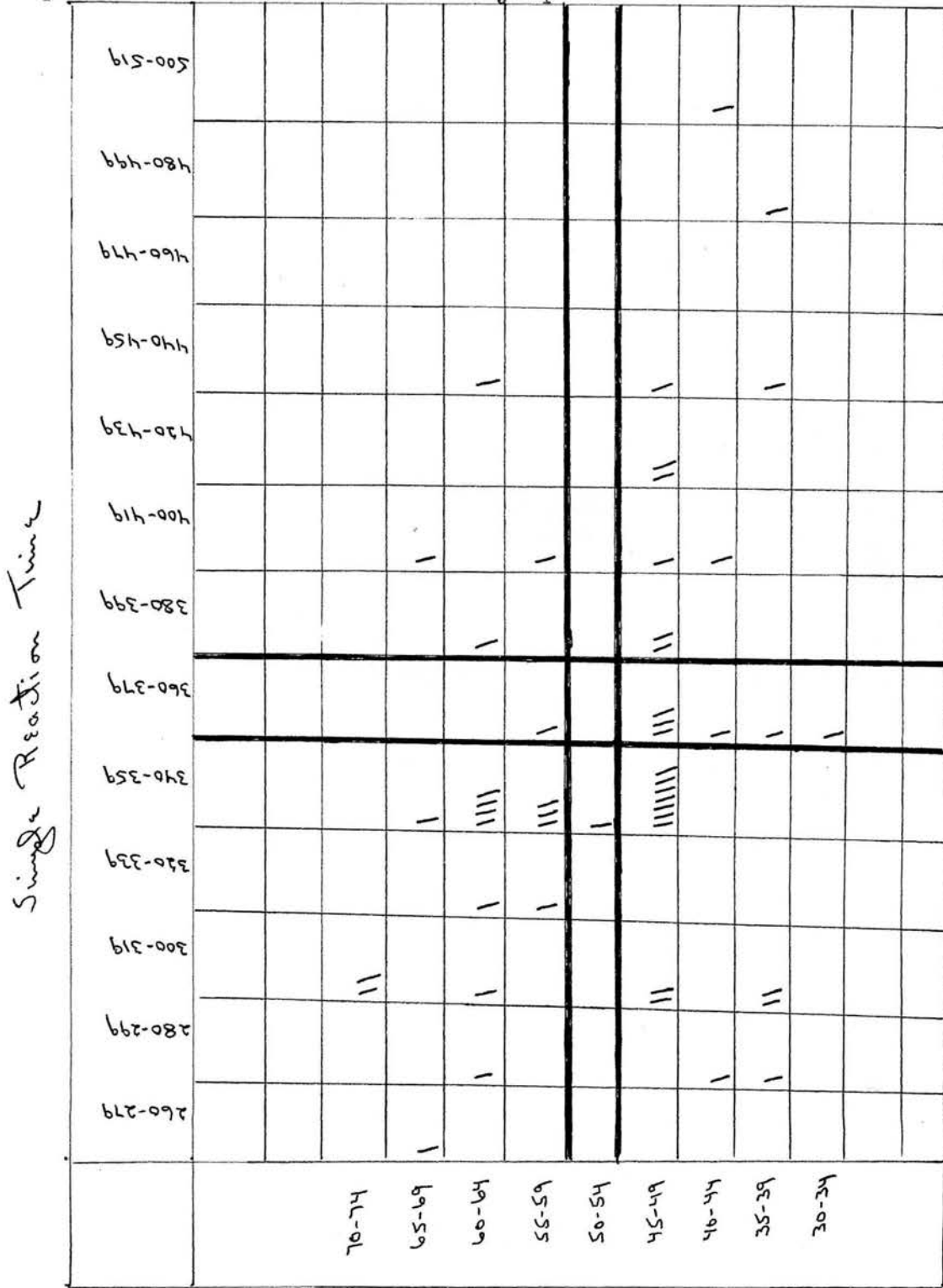
SCATTER DIAGRAM II
Simple Reaction Time and basketball throw for distance



$r = .077$ $r = .110$

Basketball Throw for Distance

SCATTER DIAGRAM III
Simple Reaction Time and broad jump



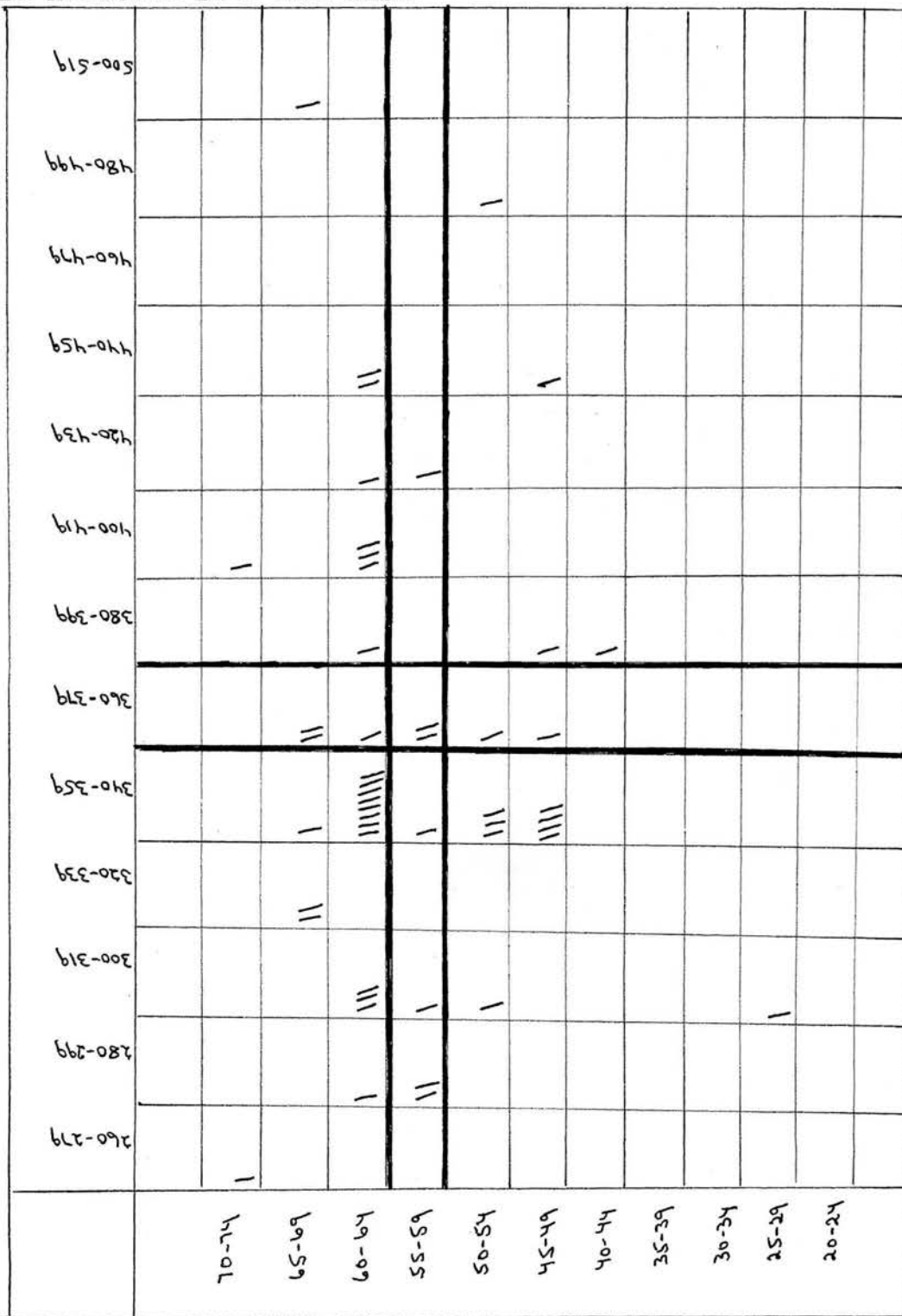
Simple Reaction Time

Broad Jump

$Y = -1.07$ $5x = .14$

SCATTER DIAGRAM IV
Simple Reaction Time and dash

Single Reaction Time

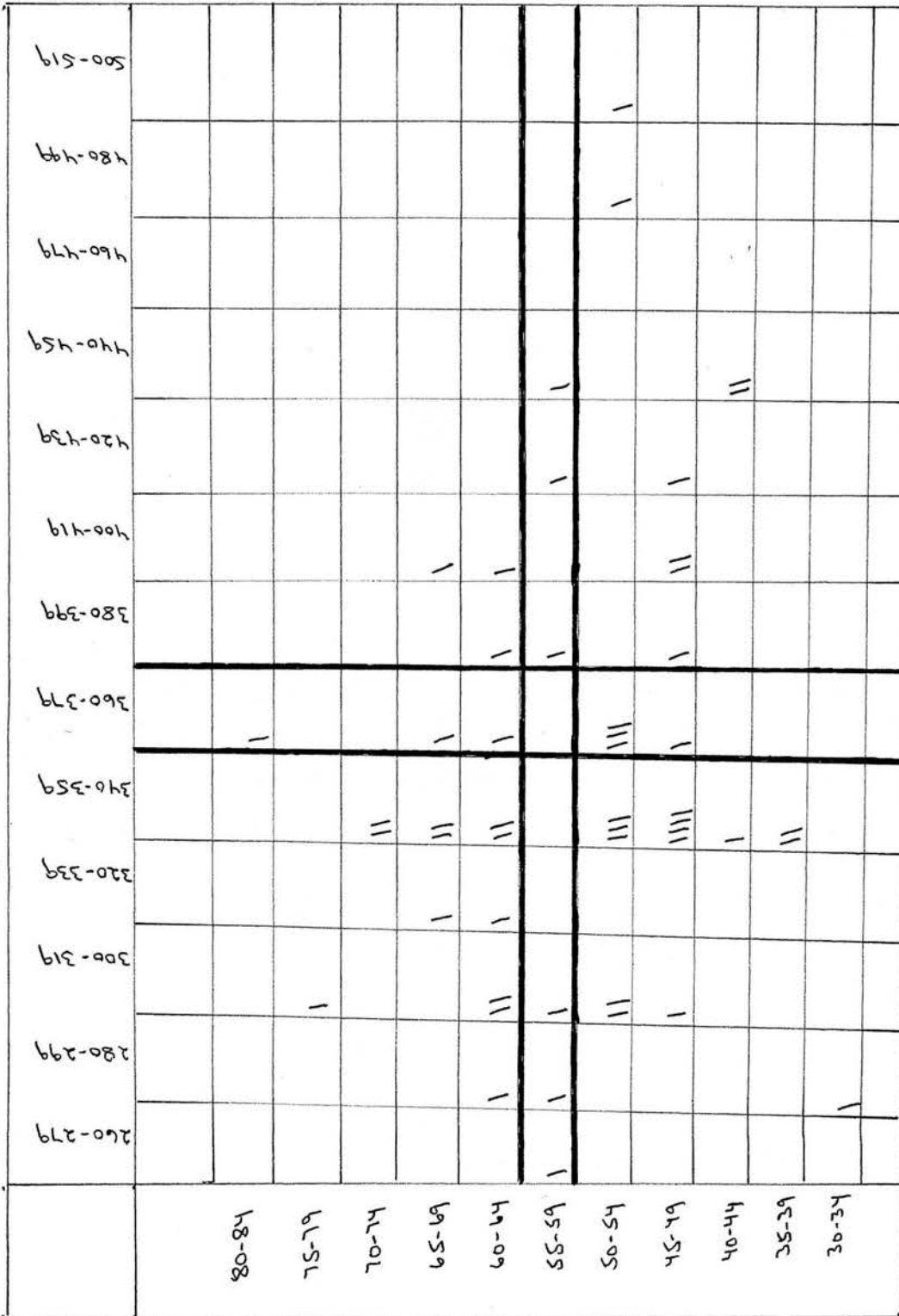


$\bar{Y} = .143$ $\sigma_Y = .138$

380

SCATTER DIAGRAM V
Simple Reaction Time and wall bounce test

Single Reaction Time



Wall Bounce Test

$Y = -.105$ $\sigma Y = .0015$

CHAPTER V
SUMMARY AND CONCLUSIONS

Summary: In this study of innate capacities the sample used was not large enough. The smallness of the sample tended to magnify the errors which are inherent in all studies of the type.

Even though the correlations were low and non-significant the author feels that further and more extensive study is justifiable. Through a thorough study of the innate capacities some very important facts may be presented to the field of Physical Education, Health and Recreation.

Conclusions: From the findings of this study the following conclusions seem evident:

1. There is no significant relationships between the General Motor Ability Test for Girls and simple reaction time.
2. There is no significant relationship between simple reaction time and any of the items in the General Motor Ability Test for Girls.
3. The highest correlation was between simple reaction time and the wall bounce test.

Recommendations for further study:

1. A study of the relationship between General

Motor Ability and span of visual apprehension, reaction time, and depth perception.

2. A similar study using girls who did not report for a varsity sport.

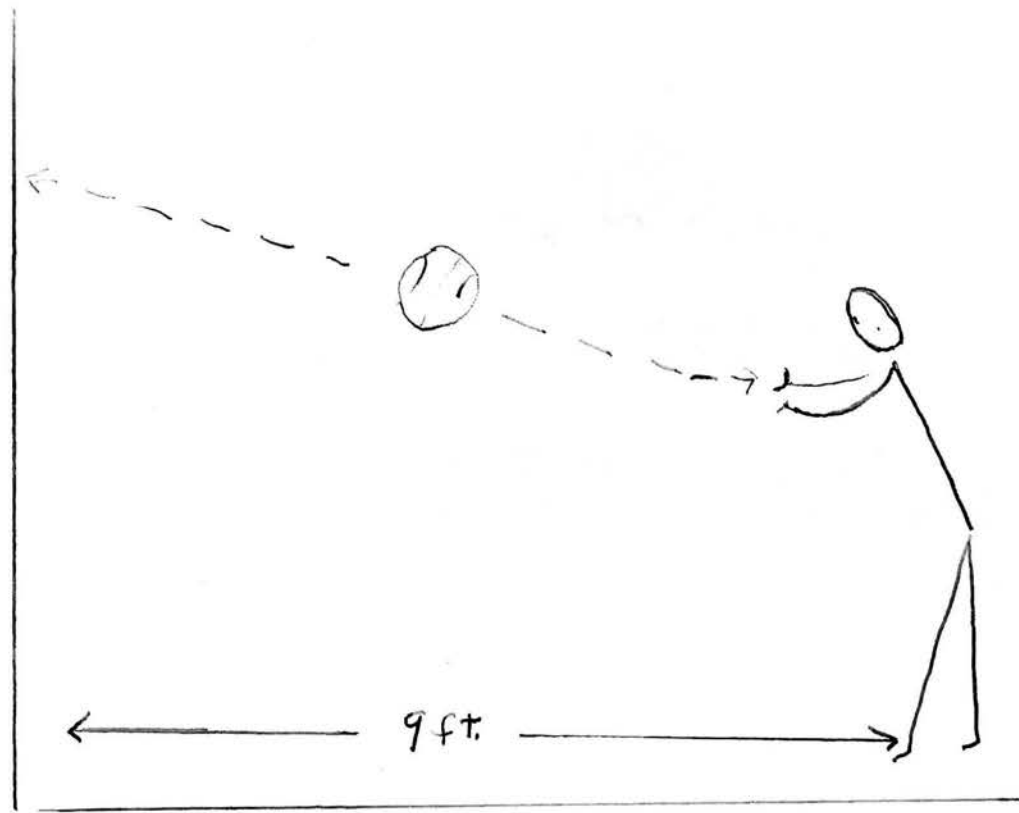
3. A similar study using sports such as - field hockey, softball, golf, etc.

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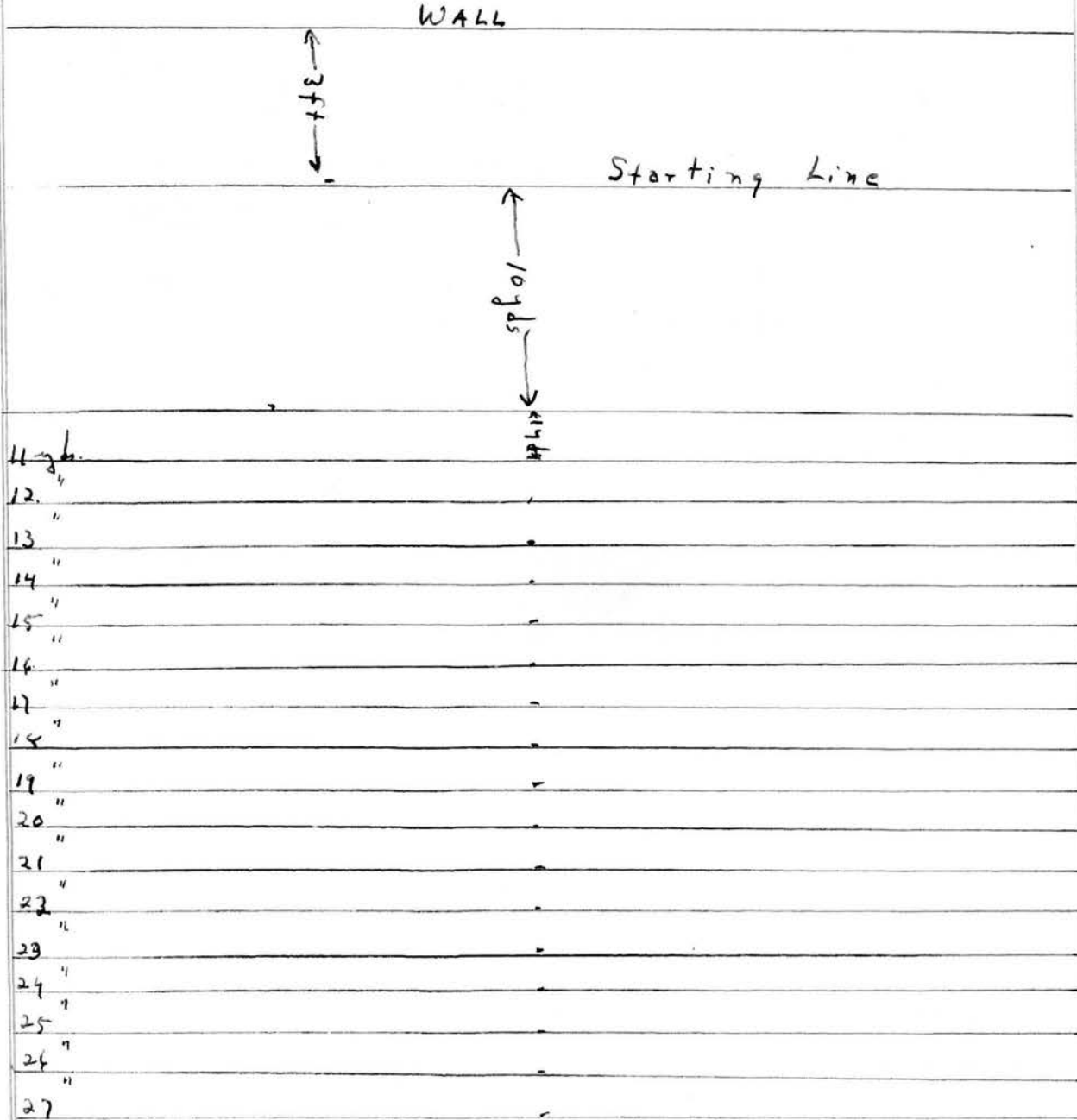
APPENDIX A

DIAGRAM OF THE WALL BOUNCE TEST USED IN THIS STUDY



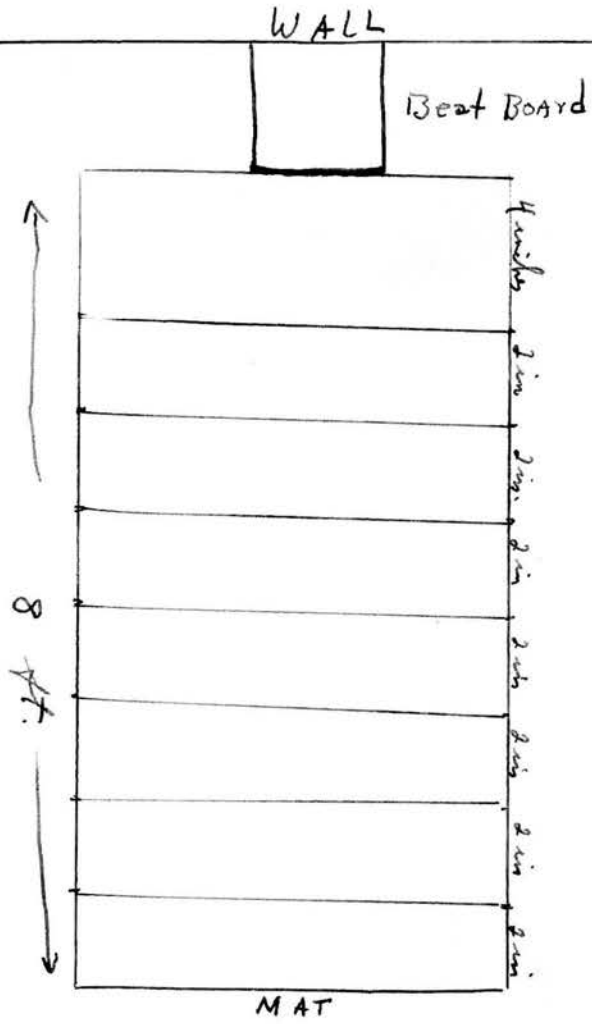
APPENDIX B

DIAGRAM OF THE DASH (4 SECONDS) USED IN THIS STUDY



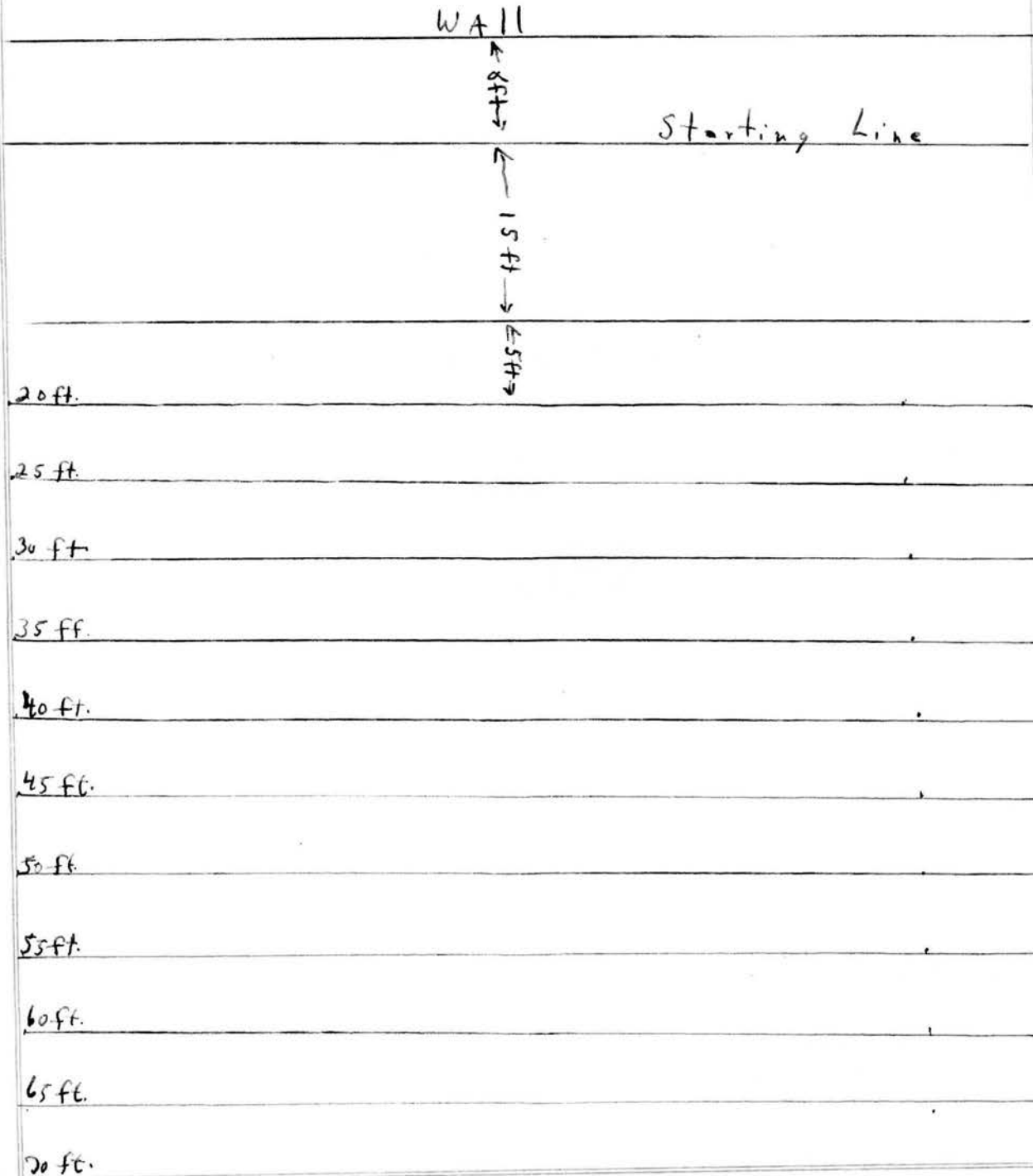
APPENDIX C

DIAGRAM OF THE STANDING BROAD JUMP USED IN THIS STUDY



APPENDIX D

DIAGRAM OF THE BASKETBALL THROW FOR DISTANCE USED IN THIS STUDY



APPENDIX E

LENGTH OF FOREPERIOD AND ORDER OF PRESENTATION OF STIMULI
FOR SIMPLE REACTION TIME TEST

SIMPLE REACTION TIME

Trial	1	2	3	4	5	6	7	8	9	10	11
Foreperiod in seconds	2	4	2	3	2	3	4	3	2	3	4