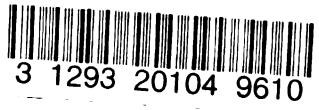
THE EFFECT OF "OVERLOAD WARM-UP" ON SPEED AND ACCURACY

Thesis for the Degree of M. A.

MICHIGAN STATE UNIVERSITY

Leroy Frank Albrecht

1958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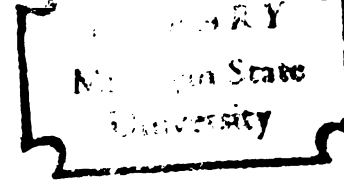
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THE EFFECT OF "OVERLOAD WARM-UP" ON SPEED AND ACCURACY

by

LEROY FRANK ALBRECHT

AN ABSTRACT OF A THESIS

Submitted to the College of Education of Michigan State
University of Agriculture and Applied Science
in partial fulfillment of the requirements
for the degree of

MASTER OF ARTS

Department of Health, Physical Education, and Recreation

1958

Approved _____

Leroy Frank Albrecht

ABSTRACT

Statement of the problem. The purpose of this study was to investigate the effect of overload in the warm-up period on the speed and accuracy of the baseball throw.

Methodology. Fifty members from the 1958 freshman baseball team at Michigan State University acted as subjects. Each subject was his own control in the regulation warm-up and the "overload warm-up" tests.

The testing program consisted of a normal baseball warm-up with ten throws recorded for speed and accuracy following warm-up. After a ten minute rest period the subjects were given a controlled warm-up with an overweighted baseball (11 ounces). Immediately following this warm-up speed and accuracy were recorded for ten additional throws.

Velocity was measured using an electric timer calibrated to 1/1000 of a second. Accuracy was measured by the score obtained on a target board. All data were statistically analyzed using the "t" test.

Ten subjects were retested using the same testing routine except no overload was used in the second warm-up.

There were no differences in velocity statistical significance without the "overload warm-up."

Conclusions. The following conclusions are drawn within the limitations of the baseball player's sample used:

1. "Overload warm-up" by throwing an eleven ounce baseball prior to throwing a regular weight ball increases the velocity at which a baseball can be thrown.

2. "Overload warm-up" ~~has no~~ significantly decreased ~~effect on~~ accuracy.

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Deep gratitude is extended to his advisor, Dr. Wayne Van Huss, for his interest and help.

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L. F. A.

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CHAPTER I

INTRODUCTION

Baseball coaches are always on the lookout for the boys with natural ability, especially those who can throw a fast ball. This ability has been regarded as innate, in that some individuals have fast contracting muscles and some slow. The immediate and longitudinal effects of training on this ability are little known though in recent years interest in the relationships of muscular power, strength, and speed of movement has increased.

A sufficient number of studies indicate that exercise will increase strength, and strength increases more rapidly when training with an overload.[1] The type of strength desired, static or dynamic, requires consideration in outlining the training program. How much though does strength

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[1] S. J. Houtz, et. al., "The Influence of Heavy Resistance Exercise on Strength," Physiotherapy Review, 26:299, 1946.

contribute to the ability to throw a baseball fast?

Relationship between strength and throwing of a baseball involves muscle power and speed of movement. Wilkins[2], conducted an investigation in speed of movement of the arms with and without weight training. He concluded that speed of movement in the arm of experienced weightlifters is as great as that of inexperienced weight trainees, and that improvement is constantly gained as training progresses. In this experiment weight training had no slowing effect on the speed of arm movement.

Capen[3], showed that systematic weight training will improve scores in power events when strength, muscular and circulatory-respiratory endurance and athletic power are improved.

This study is primarily concerned with the immediate effects of overload in a specific athletic event, using a weight in excess of the regulation weight just prior to

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[2]Bruce M. Wilkins, "The Effect of Weight Training on Speed of Movement," Research Quarterly, 23:361-370, October, 1952.

[3]Edward K. Capen, "The Effect of Systematic Weight Training on Power, Strength and Endurance," Research Quarterly, 21:83-93, May, 1950.

participation. The use of two or three bats is commonplace prior to hitting. There has been considerable diversity of opinion in baseball circles as to the use of a weighted object in pitching.

In a skilled movement the same motor units are activated in the same sequence.[4] If more load is added more motor units and muscles are activated, also if the rate is increased more motor units and muscles are activated. This study was undertaken to determine roughly that if more motor units and muscles are activated by the increased load then can these muscles and motor units be brought to bear to produce a faster rate of movement. If this is true, faster throws would result. Obviously though, even if faster throws do result the exact mechanism would still be only theoretical until the more rigorous electromyographic work can be done.

Justification of the study. Experiments have been performed in which a weighted baseball was used in the

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[4]H. C. Seyffarth, "The Behavior of Motor Units in Healthly and Paretic Muscles in Man," Acta Psychiatry, 16:79-109, 261-278, 1941.

warm-up period to determine the effect of overload on the velocity of the baseball throw.[5,6] Previous studies have all found an increase in ball velocities following warm-up with a weighted ball, but the differences have not been statistically significant. The techniques of measurement were too gross in the earlier studies. In the present study the measurement techinques have been refined and are more adequate to test the concept. The present study also includes only baseball players and the sample is larger.

Statement of the problem. To determine the effect of overload in the warm-up period on the speed and accuracy of the baseball throw.

Limitations of the problem. 1. Psychological factor. All subjects were instructed to throw at their maximum. It is difficult to determine in an all-out performance just

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[5]Randall L. Hagerman, "The Effect of 'Overload Warm-up' on the Speed of Throwing," (unpublished Master's thesis, Michigan State University, East Lansing, 1956.)

[6]Robert C. Lummer, "The Effect of 'Overload Warm-up' on Speed and Accuracy in Baseball Throwing," (unpublished Master's thesis, Michigan State University, East Lansing, 1957.)

how all-out it is since motivation plays such an important role in this respect.

Definitions. "Overload Warm-up" - the period prior to testing, in which the subject warms-up with an over-weighted baseball.

CHAPTER II

REVIEW OF LITERATURE

Little research has been done in the "overload warm-up" field. One has to limit his reading of literature to the effect of overload training to increase strength and power.

Capen[7], showed that systematic weight training will improve scores in power events when strength, muscular and circulatory-respiratory endurance and athletic power are improved. An experimental group of forty-two college sophomores trained with barbells, while a control group of twenty-nine college freshmen participated in a physical education conditioning course. Greater improvement in muscular strength, with higher final scores were recorded by the weight training group.

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[7]Capen, loc. cit.

Chui[8], disclosed that weight training increased the amount of potential power in subjects tested. Body weight, Sargent jump, eight pound shot, twelve pound shot, standing broad jump, and sixty-yard dash were performed by twenty-three subjects using weight training exercises. A control of twenty-two subjects performed the same events without a weight training program. Data were collected before and after the experiment with overload improvement in the shot put events of the trained group. Weight training had a positive effect on power.

With an increase in strength through weight training, Wilkins[9] conducted an investigation in speed of movement of the arms with and without weight training. The three groups tested consisted of novice weightlifters, team members of the University of California Weightlifting Team, and students in an elementary golf and swimming class. He found that speed of movement in the arm of experienced

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[8]Edward Chui, "The Effect of Systematic Weight Training on Athletic Power," Research Quarterly, 21:188-194, October, 1950.

[9]Bruce M. Wilkins, "The Effect of Weight Training on Speed of Movement," Research Quarterly, 23:361-370, October, 1952.

weightlifters was as great as that of inexperienced weight trainees, and that improvement is constantly gained as training progresses. In this experiment weight training had no slowing effect on the speed of arm movement.

Masley, Hairabedian, and Donaldson[10] tested an experimental and two control groups which consisted of an elementary weightlifting class, volleyball class, and students of a physical education lecture class, to determine whether weight training had any relation to strength, speed and coordination. Strength was recorded by McCloy's Strength Index. Speed of movement was measured in terms of elapsed time required to complete twenty-four rotary movements of the arm in a frontal plane. Coordination was tested by an apparatus which consisted of a front and overhead target. Copper discs were recessed in the targets and a fencing foil was wired in such a manner that contact made by the tip of the foil activated a counter. The subjects attempted to strike the copper discs as many times as possible in a required time. Results showed that speed and coordination

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[10]John W. Masley, Ara Hairabedian, and Donald Donaldson, "Weight Training in Relation to Strength, Speed, and Coordination," Research Quarterly, 24:307-316, October, 1953.

were increased by weight training.

Skubic and Hodgkins[11] studying the effects of warm-up exercises prior to certain activities which involved speed in bicycle egometer performance, strength in the throwing of a softball for distance, and accuracy in basketball free throwing, found no significant difference although all scores did increase slightly in tests preceded by related warm-ups.

Investigating the effects of related and unrelated warm-up in a softball throw for distance Michael, Skubic, and Rochelle[12], found that both types of warm-up resulted in significantly longer throws.

An experiment of overloading a baseball and its effect on the velocity of the baseball throw was performed by Hagerman.[13] The results showed that there was no significant increase in the speed of throwing by warming up with

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[11]Vera Skubic and Jean Hodgkins, "The Effect of Warm-up Activities on Speed, Strength, and Accuracy," Research Quarterly, 28:147-152, May, 1957.

[12]Ernest Michael, Vera Skubic, and Jean Hodgkins, "The Effect of Warm-up on Softball Throw for Distance," Research Quarterly, 28:357-363, December, 1957.

[13]Hagerman, loc. cit.

a weighted ball. The subjects, however, reported a feeling of relaxation and ease of throwing after the "overload warm-up" that they had not previously experienced.

Lummer[14], in a follow-up of Hagerman's study used varying loads in an "overload warm-up" experiment. He used four different baseballs which weighed seven, nine, eleven, and thirteen ounces respectively. Each subject used all four balls in four testing periods. The results showed that "overload warm-up" had no effect on speed of throwing, although an increase was found in the mean velocity scores for all four weighted balls. Also, "overload warm-up" with the second heaviest ball resulted in increased accuracy, regardless of the effect on velocity.

In all related literature it is noted that no statements of harmful effects are attributed to weight training or "overload warm-up" in speed of throwing.

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[14]Lummer, loc. cit.

CHAPTER III

METHODS OF RESEARCH

This study was planned to investigate the effect of overload in the warm-up period on the speed and accuracy of the baseball throw.

SOURCE OF DATA

Subjects. Fifty baseball players from the 1958 freshman baseball team of Michigan State University acted as subjects. All were accomplished baseball players in high school. Each subject acted as his own control in both the regulation and "overload warm-up" tests.

Experimental procedure. All players were allowed to warm-up using normal baseball procedure with a regulation baseball. After a complete warm-up, each subject recorded

ten throws for speed and accuracy during the regulation phase. After a ten minute rest the subjects continued in a controlled warm-up period using the overweighted ball. This consisted of fifteen normal throws and ten throws at maximum speed for a total of twenty-five throws in the "overload warm-up" period. Immediately folowing this period the subject recorded ten additional throws for speed and accuracy with a regulation baseball.

Retest group. Ten subjects were randomly selected from the original fifty and retested in velocity. This test consisted of two phases. The first phase was a duplication of the original test. The second phase was another duplication eliminating the "overload warm-up." The second phase of testing was conducted as a control. It is quite possible any changes found in the original testing could be due to the ten minute rest period just prior to throwing the second time rather then due to the overload. The subjects did not know the reason for the retesting.

All records were kept on previously printed five by eight filecards.

Equipment used. The type of equipment used was an electric clock, target, regulation baseball, and an over-weighted baseball.

The electric clock was calibrated to 1/1000's of a second.[15] Activation of the clock began with the release of the ball causing two contact wires to break and open the circuit. As the ball hit the target microswitches closed the circuit stopping the clock.[16]

The target was constructed of five-ply plywood with three sheets of half-inch "Absorblo" padding[17] to protect it from shattering under the constant blows of the ball. This was mounted on a thirty by fifty-six inch base, and suspended by four spring couplers. These couplers were so arranged that when any part of the target was hit, it would engage the microswitches which in turn stopped the clock. During the experiment it was found that a ball striking either the target or base would stop the clock. Scoring

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[15] Standard Precision Timers (Catalog No. 198, Springfield, Mass.: Standard Electric Time Co.), Model No. N3T-500.

[16] See Figure No. 1, p. 15.

[17] Wilson Athletic Goods (Catalog No. 191, Chicago, Ill.: Wilson Sporting Goods Co.), p. 9.

on the target was recorded by the painting of equidistant squares which were given values of five, four, three, and two starting from the inside and working out.[18]

Regulation baseballs[19] were used during the regulation warm-up and in all test periods. Under two inches of each seam of the ball a fourteen gauge copper wire was inserted to act as a contact point.

The overweighted baseball was constructed from a regulation baseball by drilling two holes through it and filling these holes with lead. The weighted ball weighed exactly eleven ounces.

The wiring technique was accomplished by taping the wire onto the body at the shoulder, arm, wrist, index, and middle fingers. At the fingertips a fraction of the wire's insulation was removed and the bare wire tucked under the contact point of the baseball. This closed the circuit and permitted the subject more freedom in gripping the ball. The wire was attached to the clock by a jack plug, as was

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[18] See Figure No. 2, p. 15.

[19] Baseball Almanac (New York: A. S. Barnes and Company, Inc., 1949), p. 46.

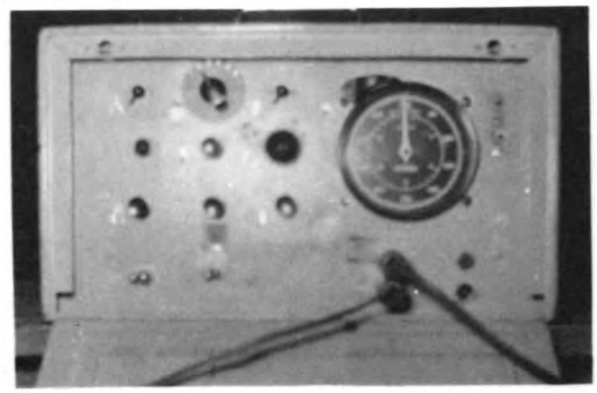

Figure No. 1

Reaction Timer with 1/1000's of a second clock. Top jack plug, wire to subject. Bottom jack plug, wire to target.

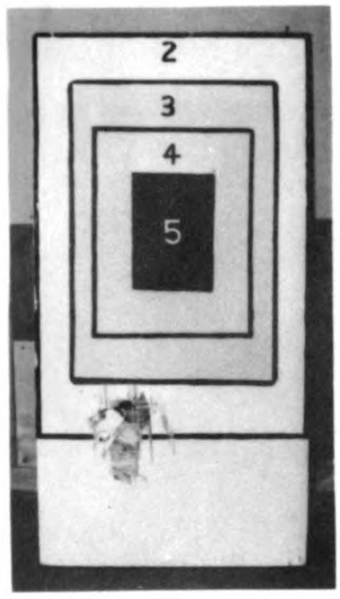

Figure No. 2

Target, showing scoring area for accuracy.

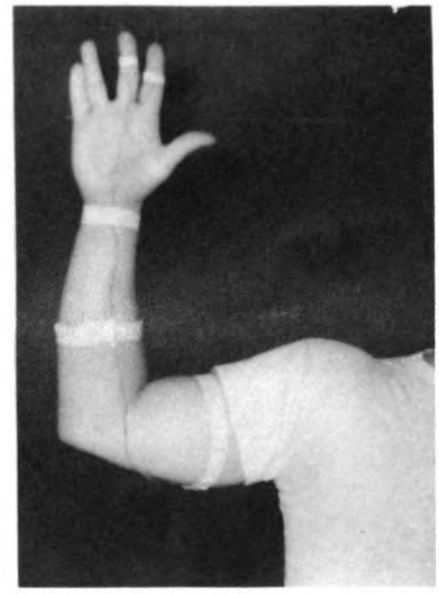

Figure No. 3

Subject wired for testing.

the wire from the target.[20]

The throwing area was reduced to 30'3 inches due to the frequent missing of the target which was experienced in earlier studies.

Accuracy of this device was checked by the ball drop method. The error was found to be ± .0007 of a second, less then could be accurately read on the clock.

Statistical technique. The statistical technique employed in this study was the "t" test for significance for matched pairs.[21] It was possible using this technique to compute the difference between regular warm-up, "overload warm-up" and the retest group data.

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[20] See Figure No. 3, p. 15.

[21] Allen L. Edwards, Fundamental Statistics (New York: Rinehart and Company, Inc., 1946), pp. 173-175.

CHAPTER IV

RESULTS AND ANALYSIS OF DATA

This study was planned to investigate the effect of overload in the warm-up period on the speed and accuracy of the baseball throw. Fifty candidates from the university baseball team served as the subjects. Two tests were administered, one after a regulation baseball warm-up and one after an "overload warm-up" period. The results of all data collected are contained in this chapter and are divided into two parts, velocity and accuracy.

I VELOCITY

Treatment of data. The mean velocity scores recorded for regulation warm-up and "overload warm-up" were arranged according to the appropriate warm-up group and tested for significance using the "t" test.

Results. A mean velocity of .340 seconds was found for regular warm-up as compared to .316 seconds for "overload warm-up." The mean difference was .024 seconds, indicating the subjects threw faster after the "overload warm-up." This mean difference was statistically significant at the 1% level (t = 5.71).[22]

Discussion. Ten of the fifty subjects scored lower means after the "overload warm-up" with one subject's score remaining constant. The difference in these means ranged from .002 seconds to .044 seconds, while improvement after "overload warm-up" ranged from .001 seconds to .095 seconds.

A factor that is unknown here is whether or not the subject was thoroughly warmed up prior to the first test. The only indicators of proper preparation were the supervised team warm-up and the subject's integrity. Since this would be an obvious limitation to the study ten of the original subjects were randomly selected and retested. The retest was exactly the same as the original testing except that no "overload warm-up was included. The data

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[22]Basic data is found in Appendix A.

for these ten cases were statistically analyzed to determine: (1) significance of regular and "overload warm-up" in the initial testing ($t = 7.27$, $P = .01$), (2) significance of retest data, regular vs. regular warm-up administered in exactly the same sequence as in the initial testing ($t = .735$, not significant), (3) significance of the differences in the initial testing when compared with the differences in the retesting ($t = 8.83$, $P = .01$). The latter data indicate the significance obtained in the initial testing of the fifty subjects was not due to the testing routine, but to the "overload warm-up."[23]

An interesting psychological factor was observed after "overload warm-up." The subjects expressed a feeling of being able to throw much faster.

II ACCURACY

Treatment of data. The mean accuracy scores recorded for regulation warm-up and "overload warm-up" were arranged according to the appropriate warm-up group and tested for significance using the "t" test.

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[23]Basic data is found in Appendix C.

Results. The results showed a mean of 3.57 points after regulation warm-up as compared to the 3.32 points after "overload warm-up." The mean difference in scores was .248, indicating the subjects scored less points after the "overload warm-up." This mean difference was statistically significant at the 1% level ($t = 3.27$, $P = .01$).[24]

Discussion. Eleven subjects scored higher individual accuracy mean scores after "overload warm-up" but, only four subjects had a mean accuracy score above the general overall test mean following the regular warm-up test. Study of the data showed that subjects who scored very low in test one had a tendency to raise their means in test two. While subjects with very high means in test one, scored lower in test two. After the "overload warm-up," testing revealed that all subjects had a tendency to throw low. This noticeable decline in accuracy was due to the fact that all subjects needed more than the allowed practice throws to regain their accuracy. All scores for the first three throws following "overload warm-up" where decidedly lower in most cases. In addition, the investigator in all tests emphasized to each subject to concentrate on speed and not accuracy.

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[24]Basic data is found in Appendix B.

CHAPTER V

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

This study was planned to investigate the effect of overload in the warm-up period on the speed and accuracy of the baseball throw.

Fifty university freshman baseball team candidates served as subjects. Acting as their own controls, each subject participated in two tests. The first test was administered after a regulation baseball warm-up, after which a regulation baseball was thrown and recorded for accuracy and speed. Following a ten minute rest period each subject continued in a controlled warm-up period with a baseball weighing eleven ounces. Immediately following this "overload warm-up" the subjects recorded an additional ten throws for speed and accuracy. Ten subjects from the original fifty subjects were selected randomly and retested in the exact manner as before, but without the inclusion of

"overload warm-up."

The data were statistically analyzed using the "t" test. The results indicate the subjects threw significantly faster after "overload warm-up" ($t = 5.71$, $P = .01$), but were slightly less accurate ($t = 3.27$, $P = .01$).

Retesting of a group of ten subjects using the same procedures as in the initial testing further corroborated the initial data and indicate the improvements were not due to the rest period in the testing procedure.

CONCLUSIONS

The following conclusions are drawn within the limitations of the baseball player's sample used:

1. "Overload warm-up" by throwing an eleven ounce baseball prior to throwing a regular weight ball increases the velocity at which a baseball can be thrown.

2. "Overload warm-up" ~~has no~~ significantly decreased ~~effect on~~ accuracy.

RECOMMENDATIONS

1. It is recommended in future studies that the velocity of throwing be recorded through the use of electronic grids.

2. A better and more effective system of scoring accuracy on the target be developed.

3. An overweighted ball should be constructed in complete balance. This would facilitate a more normal throw in the "overload warm-up."

4. A sample of more experienced baseball players should be tested.

5. The longitudinal effects of "overload warm-up" should be studied.

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APPENDICES

APPENDIX A

MEAN VELOCITY SCORES

Subject	Regular Warm-up	Overload Warm-up	Subject	Regular Warm-up	Overload Warm-up
KA	.326	.294	TM	.372	.381
LA	.312	.311	DN	.332	.375
BB	.240	.240	JN	.333	.340
JC-1	.316	.299	RO	.368	.318
JC-2	.387	.292	JP	.478	.449
WC-1	.365	.315	RP	.326	.311
PC	.313	.264	RR	.304	.258
JC-3	.320	.290	ER	.434	.415
WC-2	.367	.369	TR	.271	.264
DE	.285	.259	PS-1	.333	.278
JE	.314	.292	DS	.347	.355
TE	.288	.295	MS	.339	.326
ME	.338	.279	PS-2	.424	.344
GG	.377	.365	TT-1	.317	.361
LG	.299	.267	BT	.309	.268
NH	.327	.354	CT-1	.254	.223
SH	.370	.356	LT	.339	.356
TJ	.418	.378	TT-2	.425	.394
HJ	.419	.363	CT-2	.422	.380
JK	.298	.266	JV	.345	.282
DK	.358	.341	CW	.308	.260
JL	.321	.239	GW	.363	.351
AL	.340	.288	TW	.326	.312
BM	.294	.257	KW	.345	.330
DM	.302	.313	IZ	.300	.286
			Mean	.340	Mean .316
			SD	.044	SD .051

APPENDIX B

MEAN ACCURACY SCORES

Subject	Regular Warm-up	Overload Warm-up	Subject	Regular Warm-up	Overload Warm-up
KA	3.9	3.2	TM	3.6	3.3
LA	3.7	3.1	DN	3.2	2.9
BB	3.7	2.7	JN	3.8	3.5
JC-1	4.1	4.3	RO	3.4	2.8
JC-2	3.2	4.1	JP	3.4	3.3
WC-1	2.5	2.5	RP	3.7	3.3
PC	3.7	3.7	RR	3.7	3.3
JC-3	2.3	3.0	ER	3.6	2.8
WC-2	3.4	3.5	TR	3.4	2.9
DE	3.4	2.5	PS-1	3.7	4.1
JE	3.4	3.8	DS	3.9	3.7
TE	4.0	4.0	MS	3.9	3.5
ME	4.4	3.8	PS-2	3.5	1.8
GG	2.7	3.0	TT-1	3.9	3.5
LG	3.8	3.5	BT	3.5	2.5
NH	3.8	3.6	CT-1	3.7	4.1
SH	3.2	3.8	LT	2.6	3.1
TJ	3.6	3.2	TT-2	3.9	2.3
HJ	2.8	3.6	CT-2	4.1	4.2
JK	3.3	3.6	JV	4.2	3.5
DK	4.3	3.0	CW	3.8	3.3
JL	4.0	3.6	GW	3.2	3.7
AL	3.6	3.3	TW	4.2	4.3
BM	3.5	3.3	KW	2.8	2.9
DM	3.1	3.2	IZ	3.7	3.9
				Mean 3.57	Mean 3.32
				SD .51	SD .33

APPENDIX C

MEAN VELOCITY SCORES

RETEST GROUP

Subject	INITIAL TEST Regular Warm-up	INITIAL TEST Overload Warm-up	RETEST Regular Warm-up	RETEST Regular Warm-up	Mean D Initial Test	Mean D Retest
LA	.309	.281	.349	.352	.028	-.003
BB	.242	.228	.276	.289	.014	-.013
JC-2	.348	.286	.373	.371	.062	.002
JE	.297	.277	.303	.317	.020	-.014
ME	.290	.266	.293	.303	.024	-.010
JK	.305	.279	.365	.360	.026	.005
BM	.330	.269	.333	.336	.031	-.003
DN	.342	.301	.412	.416	.041	-.004
TW	.334	.291	.333	.347	.043	-.014
BT	.269	.243	.224	.225	.026	-.001
	Mean	Mean	Mean	Mean	Mean	Mean
	.304	.272	.326	.331	.031	-.0055
	SD	SD	SD	SD	SD	SD
	.0269	.0222	.0171	.0171	.017	.00655