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THE EFFECT OF MOTIVATION ON LOW VELOCITY MAXIMAL ISOKINETIC TORQUE

by

© Charles Armstrong

A Thesis

Submitted to the Faculty of Graduate Studies and Research in Partial Fulfillment of the Requirements for the Degree of Master of Science

Department of Physical Therapy
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THE EFFECT OF MOTIVATION ON LOW VELOCITY MAXIMAL ISOKINETIC TORQUE

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To my mother who gave me the desire to excel and
to my father who gave me strength and perseverance.

ABSTRACT

In the field of sports medicine there is need for an accurate measure of knee torque. If taken post-injury and compared with the pre-season values, this score would allow a sports medicine specialist an objective means of determining when an athlete with knee pathology could return to competition. The Cybex II Isokinetic Exercise Unit provides such a measure. However, in a retest situation, a variety of motivational factors may affect the effort that the athlete expends during the test and thus produce less than consistent torque values. In this case a highly motivated athlete may falsely appear to be at an acceptable strength level for return to competition and thus be placed on the playing field with a compromised limb. The extent to which the motivational situation during testing may influence peak isokinetic torque values has not been extensively investigated. Therefore, there is a need to examine the effect of motivation on maximal strength effort.

The present study was designed using fifty male subjects between the ages of sixteen and nineteen years of age. These subjects were tested on the Cybex Dynamometer and then randomly assigned to five groups. The groups were retested under varying motivational situations: positive verbal, negative verbal, financially rewarding, peer pressure and control. The results of the

retest were compared using repeated measures of analysis of variance and covariance as specified in the 1981 BMDP IV Program.

It was found that the motivational environments did not significantly alter the results in the tape-recorded, high verbal motivation; the tape-recorded, low verbal demotivation; or the money motivation groups. However, when the subjects were surrounded by peers during the retest situation, and the peers were giving vigorous verbal encouragement, there was a significant increase in strength performance.

The hypothesis on reducing inhibition to increase strength is in part supported by this study.

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STATEMENT OF THE PROBLEM

Introduction

Sports Medicine is a rapidly growing and developing discipline in the Canadian sporting community. The unique health care needs of the athlete are being increasingly recognized and accepted by the public, physicians, exercise physiologists, and sports therapists. The pre-season medical examination, which at one time was either optional or unstandardized, is now very comprehensive and includes a thorough battery of medical tests, as well as a wide range of strength tests (51).

Within the area of strength testing, many devices have been used and are continually evolving to improve this form of examination. Originally, strength testing was limited to a subjective evaluation by a therapist providing manual resistance to a variety of movements that the athlete might be required to perform (26). More recently, specialized equipment and instrumentation have been developed to permit a more precise evaluation of muscle strength about different joints and at various joint angles.

One such instrument is the Cybex II Isokinetic Exercise Unit (Cybex). The Cybex employs the principle of accommodating resistance combined with constant speed of movement, making it an isokinetic exercise devise (31, 75). The accomodating resistance specific to this apparatus is provided by an electro-mechanical breaking mechanism, which also accounts for the very accurate and reliable measures of torque (53, 78, 80). The Cybex limits the maximum angular velocity of the resistance arm to a specific selected speed, from zero degrees to three hundred degrees per second (31, 35, 64, 75). Near maximal muscular effort throughout the complete range of movement of a joint is possible and a written record of the resistance torque provided by the resistance arm (which equals the effort torque produced by the muscle and limb segment) is provided (18, 35).

The level of resistance provided and recorded by the Cybex is totally dependant upon the level of output or force directed against the resistance arm by the subject. Even in this setting, the evaluation of maximal effort on each effort must be determined by observing the recorded values of peak torque and noting if there is a smooth progression in peak torque values (indicating maximum output) or an irregular series of peak torque values indicating a sub-maximal and inconsistent effort (47). Investigations have indicated that it is improbable that a subject can produce a series of similar sub-maximal effort curves with less than ten percent variation in peak torque (4, 35).

One commonly recorded parameter in the pre-season medical examination is peak isokinetic torque for knee flexion and knee extension. This test is carried out because the knee is a very commonly injured joint and the torque values observed in a pre-season test provide an objective measurement of maximal knee flexion and knee extension strength which can then serve as a baseline for determining adequate muscular strength for returning the individual to full activity following an injury. It is a commonly accepted, although rarely written standard in sports therapy, that the decision to return to the playing field is made for an athlete with an injured knee when maximal peak isokinetic torque values on the Cybex are within five to ten per cent of pre-season values (21, 26, 46).

The role that motivation may play in these maximal effort strength tests for the recovering athlete has been given minimal consideration, if not totally ignored. Actual strength scores obtained on the Cybex may reflect the degree to which the subject is motivated to expend maximal effort in a retest situation. In a positive motivational environment, a subject may record higher scores than would the same subject in an environment that did not stimulate the subject to perform with a similar effort. Consequently, a highly motivated athlete may be retested following an injury and subsequent rehabilitation program, and may score within five per cent of his pre-season test score, but his actual physical strength may not be within five per cent of that observed pre-season. The result, in this situation, could be that the athlete would be returned to practice and competition prematurely.

Purpose of the Study

The purpose of this study was to examine the ability of normal individuals to exert maximal strength efforts under different motivational situations. More specifically, the study attempted to determine if peak isokinetic torque values during two retest situations using the Cybex were:

1) greater with tape-recorded, high verbal motivation, and/or greater with monetary motivation, and/or peer pressure motivation than torque values observed during a standard test situation, and;

2) less with tape-recorded, low verbal motivation than the torque values observed during a standard test situation.

Delimitations

The study was restricted to the following:

1. One speed on the Cybex (thirty degrees per second) (35, 53).
2. Testing extension of the right knee joint, an action attributed primarily to contraction of the quadriceps muscle group.
3. Examination of fifty males between sixteen and nineteen years of age, with no history of knee pathology.

4. A single five minute familiarization session on the Cybex apparatus, performing the specific reciprocal knee extension-flexion movement, immediately prior to the first test.
5. A brief practice period at the beginning of each test situation during which time the subjects reacquainted themselves with the apparatus by performing five submaximal knee extensions and knee flexion efforts (35, 36).

Limitations

1. The precision of torque records was limited to the recording accuracy of the Cybex II Isokinetic Exercise Unit manufactured by the Lumex Corporation of New York.
2. The ability of each subject to exert a maximal effort during each test situation and the individual subject's perception of maximal effort were beyond the control of the investigator.

Definition of Terms

1. Isokinetic Exercise: concentric work performed at a constant speed on a single channel Cybex Exercise Unit. The resistance provided accomodates to the effort expended against the resistance arm by the subject.

2. Peak Torque: the maximum torque exerted within the range

of movement, where torque equals force times distance and the torque record is provided by the Cybex.

3. Motivational Situations: the subject was instructed to exert maximal effort throughout the test routine while selected music was played over a stereo system:

(a) Standard Motivation: during the test sequence a tape recording of standard verbal instructions and encouragement was played. The encouragement offered was moderate and was delivered in a tone of voice just above normal. This standard instruction tape recorded was accompanied by another tape recording of unobstrusive background music (fifteenth century Praetorius);

(b) Tape Recorded, Low Verbal Motivation: during the test sequence, tape recorded, low verbal instructions and encouragement was played. The encouragement offered was minimal and was delivered in a normal tone of voice. Tape recorded background music which was considered to be of a solemn nature was played (Chopin's Nocturnes);

(c) Tape Recorded, High Verbal Motivation: during the test sequence, tape recorded, high verbal instructions and encouragement was played. The encouragement offered was in a loud, shouting, demanding, coach-like tone of voice. The tape recorded background music played during the test sequence was of a vigorous and exciting nature (Sex Pistols);

(d) Monetary Motivation: during the test sequence, tape recorded instructions and music were similar to the tape recorded Standard Motivation Instructions. During the test sequence, verbal feedback was provided on how close the subject was to earning money and how much;

(e) Peer Pressure Motivation: during the test sequence, tape recorded instructions were played. These instructions and music were similar to the tape recorded Standard Motivation Instructions. During the test sequence, five members of the same group stood in front of the subject being tested, as shown in Figure 1, providing verbal and visual encouragement.

Hypothesis

The following null hypothsis were investigated:

The peak isokinetic torque values recorded on the Cybex II Isokinetic Exercise Unit for the quadriceps muscles showed the following: 1) no statistically significant differences between the tape recorded, high verbal, the monetary and the peer pressure motivational situations and the standard situation, and; 2) no statistically significant difference between the tape recorded, low verbal motivational situation and the standard situation.

Figure 1. Peer Pressure Motivation

CHAPTER II

REVIEW OF THE LITERATURE

Researchers and clinicians have long struggled with the task of accurately measuring strength parameters of the human body (82). Conventional strength testing apparatus has utilized modified spring scales or strength dynamometers such as the Hand-Grip Dynamometer and the Back and Leg Dynamometer. The Cable Tensiometer has appeared extensively in the literature as a versatile and an accurate device for measuring strength (9, 10).

In his text on applied measurement in physical education, Montoye (58) stated that the measurement of strength is time consuming. Furthermore, testing can cause minor strains as the result of the expenditure of maximal effort and, consequently the safety of the person being tested is dependent, to a great extent, on the degree of expertise of the testor. Although maximal voluntary muscular strength is an often used parameter, the safety measures adopted by the tester(s) has rarely been discussed.

Beginning in the late 1960's, the Lumex Corporation of New York marketed a new approach to strength measurement with the introduction of the Cybex Isokinetic Exercise Unit (Cybex) (4, 16, 18, 21, 27, 31, 35, 36, 38, 41, 47, 53, 55, 61, 62, 63, 64, 68, 72, 80).

Prior to 1967, the literature clearly pointed toward the need for a scientifically acceptable apparatus for measuring strength (50, 51, 70, 79, 82). Figure 2 illustrates a Cybex Isokinetic Exercise Unit Speed Selector, Recorder, and Dynamometer.

Isokinetic strength training equipment includes centrifugal and friction devices (Mini-Gym), hydraulic devices (Orthotron) and the Cybex, which is an electro-mechanical device (47). The Cybex is currently the most versatile dynamometer and is the one most commonly used in the literature (53, 54, 55, 66, 67, 80). The Cybex has been demonstrated to provide reliable, valid and objective information, with a variety of testors (5, 27, 35, 36, 53, 78, 80).

The Cybex was originally designed for strength testing about the knee joint and much of the published literature having used Cybex testing refers to the knee joint (18, 21, 23, 27, 28, 35, 36, 47, 53, 64, 68, 72). This testing can be related to two factors: 1) the knee is one of the most commonly injured joints; and, 2) knee extension-flexion testing is simple to conduct. In the measuring of quadriceps and hamstring strength, the literature states that the slower speed setting on the Cybex should be used. With speed settings higher than thirty degrees per second, the optimal mechanical position of the joint is passed before maximal tension can be reached. An appropriate speed setting for strength measurements with the Cybex is thirty degrees per second (28, 53).

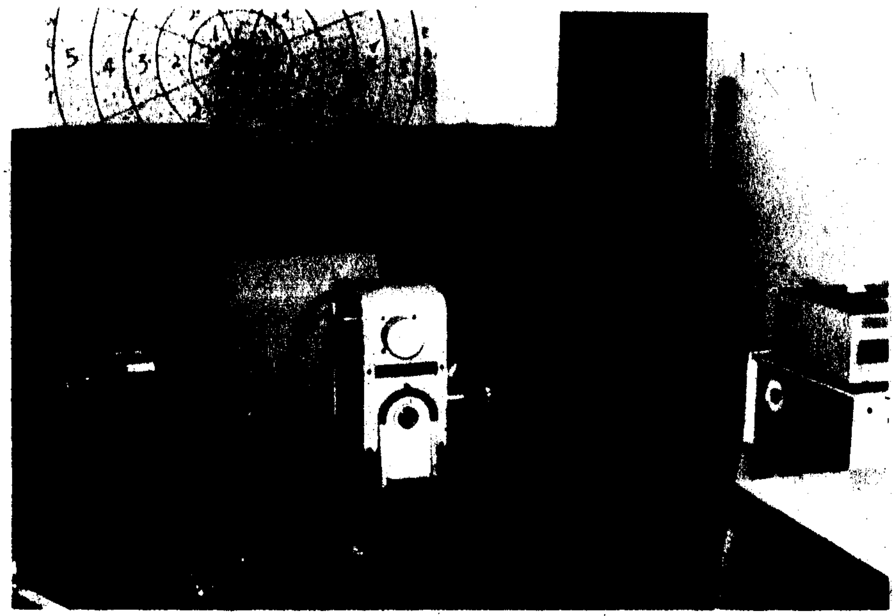

Figure 2. The Cybex II Isokinetic Exercise Unit

The Cybex has a fixed axis about which rotation occurs. Optimally, the knee also represents a fixed axis. Unless the two axes coincide, the Cybex cannot accurately measure torque about the knee. When testing the muscles about the knee with the Cybex, most researchers support the position suggested by the Cybex manufacturer (35), that when testing, it is important to ensure that the axis of the lever arm be aligned with the joint being examined (28, 35, 47, 55, 62, 78).

During testing, it is important that the remainder of the body be stabilized. The following body segments have been restrained in other investigations: the pelvis - to prevent pelvic tilt (32, 72); the upper torso - to be held to the seat back (28); some have suggested that the arms be crossed (28), others have suggested that the subject grip the sides of the chair (35); and the free thigh and the thigh of the tested leg should be well secured (28, 79). Scudder (72), in his study of torque curves at the knee joint, considered it necessary to use backrest inserts on the Cybex chair to accommodate for femur length variations. With this modification Scudder (72) was able to maintain a standard distance between the edge of the table and the back of the subject's leg and still had the axis of the knee and axis of the Cybex coinciding.

Since there is some individual difference in the optimal knee joint angle for obtaining peak torque isometrically, Murray et al. used isokinetic measures of strength for obtaining strength measures (60). The most common measurement made from the torque curve is peak torque, which is the highest point on the curve regardless of joint ankle (38, 41, 54, 57, 68). These values may be expressed in absolute values, foot-pounds of torque (41, 43, 53, 54, 63). To achieve maximal scores, the subject should be given a brief familiarization or warm-up (35, 36) on the Cybex and then be instructed to perform three maximal effort extension/flexion cycles of the knee joint (44, 57). The highest value of the three is used as the peak torque value (37, 72). Scudder (72) suggested that the subjects may be tested every day, while Jones (37) suggested that testing on alternate days provides a more adequate recovery time.

The question as to whether motivation plays an important role in muscle testing is unanswered. Whether the level of motivation developed by the tested subject, either positively or negatively influences the scores obtained during a test sequence is of considerable practical importance. During a muscle test or when attempting to have a patient initiate or amplify a particular movement, it is a common practise in physiotherapy for the therapist to offer words of encouragement as motivation, while the activity is being performed. Whether this positive environment created by the therapist enhances work output from the patient or whether reinforcement is a factor in the maximal testing of non-pathological conditions has not been considered in the available literature.

Caldwell (5) and Clark (7) stated that a motivated individual will score significantly higher than will an individual who is not motivated. Simonson (73) considered motivation to be the largest uncontrolled variable in muscle testing for strength and added that this is particularly true in the case of untrained individuals. Borg et al. (3) agreed, stating that a demotivated individual will produce submaximal scores.

Ikai and Steinhaus (33) demonstrated that human maximal strength is linked to psychologically induced inhibition, attributing increased maximal strength performances to a reduction in inhibition. When considering the testing of maximal strength of muscles, Jones (37) stated that one of the most obscure variables of muscle testing was motivation.

The indiscriminant use of subtle verbal statements or encouragement has long posed the question of their effect on the reliability of strength measures.

Despite the fact that it has long been recognized that motivation may play a significant role in strength measure parameters, few researchers have openly approached the issue (70). Moffroid et al. (53) clearly stated that consideration must be given to motivation when a subject is performing a maximal effort. Some researchers support the statement that motivation plays a critical role in the scores obtained during muscle testing (3, 5, 7, 33, 50, 53, 70, 73), but do not have scientific evidence to support this position.

Despite the belief that motivation is directly related to strength, in many of the studies examining motivation and strength testing, motivation has not been observed to be an important factor in the outcome of the test scores (37, 69, 84). In 1962, Jones (37), using a custom made cable tensiometer device, found that the maximal isometric strength score was reliable, regardless of the motivational situation. In testing grip strength, Tyan (69) observed that motivation did not effect the strength scores. Schenek (70) using cable tensiometry on the knee extensors, found no increase in strength scores when offering the subjects motivation by way of positive feedback on their previous test. Wilmore (84) suggested that supramaximal performance results from the breakdown of psychologically inhibitory barriers or positive motivation. Yet, this study, using bicycle testing and motivation, found no significant positive gains with motivation.

Currently there exists a gap in knowledge as well as a gap between existing knowledge and clinical practice. The examination of motivation in conjunction with isokinetic exercise has not been reported in the available literature. Despite the fact that the literature does not support the suggestion that motivation plays a role in maximal strength effort, clinicians continue to use motivation, particularly verbal motivation, in the hope of improving the subject's or patient's effort.

It has been established that the Cybex provides a standard, reliable means of accurately measuring peak torque at the knee joint during the knee extension-flexion cycle (53, 78, 80). An investigation using the Cybex Isokinetic Exercise Unit was conducted to determine whether positive motivation could significantly increase peak strength measures during voluntary maximal effort and, conversely, whether negative motivation could significantly decrease peak strength measures during a voluntary maximal effort. Such information is crucial if therapists are to appropriately rehabilitate patients and return them to previous endeavors.

CHAPTER III

METHODS AND PROCEDURES

The Cybex II Isokinetic Exercise Unit (Cybex), was utilized to examine the peak isokinetic torque values produced under five motivational situations. Established Cybex testing procedures (18, 21, 23, 27, 28, 35, 36, 47, 53, 64, 68, 72), were followed through testing and recording of peak torque values of the right quadriceps muscle group.

The Sample

Fifty male subjects between the ages of sixteen and nineteen years of age with no history of knee pathology were examined in this study. Each subject signed an "Informed Consent Form" (Appendix A). The subjects were told nothing about the motivational situation except that they were to come to be tested three times and that they were to follow instructions. Following the initial test (standard motivational situation), the fifty subjects were ranked from strongest to weakest on the basis of peak torque strength scores. These ordered subjects were then systematically assigned to groups in the following manner:

1.	strongest subject	Group A
2.	next strongest subject	Group B
3.	third strongest subject	Group C
4.	fourth strongest subject	Group D
5.	fifth strongest subject	Group E
6.	sixth strongest subject	Group E
7.	seventh strongest subject	Group D
8.	eighth strongest subject	Group C
9.	etcetera	

These five groups of ten subjects each were then randomly assigned (by drawing from a hat) to test groups: Group 1 - Standard; Group 2 - Tape Recorded, Low Verbal Motivation; Group 3 - Tape Recorded, High Verbal Motivation; Group 4 - Money Motivation, and Group 5 - Peer Pressure Motivation. Figure 3 shows the division of the subjects into five equal groups of ten subjects each and outlines the time sequence of testing. A one-way analysis of variance was utilized to compare the mean peak isokinetic torque values of the five groups on knee extension to ensure that there was no stastistically significant difference between the five groups following the initial test. Had a statistically significant F-radio been observed ($P < 0.05$) in the random group assignment, then the random grouping would have been redone until a non-statistically significant F-ratio would have been observed.

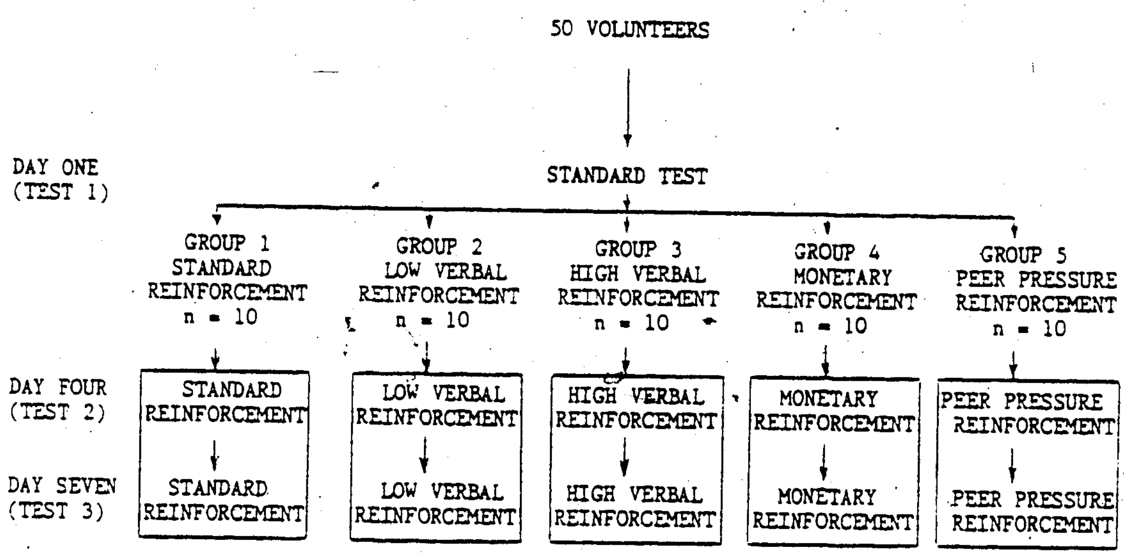

Figure 3. Time Sequence Events Flow-Chart Followed During Testing

The Test Environment

Testing was carried out in a three meter by six-meter room in the motor learning laboratory in the Physical Education Centre at the University of Saskatchewan, Saskatoon. Figure 2 shows the Cybex Unit set up at one end of the room along with the portable Sony tape recorder which was placed on the unused Cybex seat. This recorder was used for instructions. At the other end of the room was a Sony stereophonic tape player with four speakers positioned on opposite sides of the room and directed toward the Cybex Unit as shown in Figure 4. This recorder was used for music.

The Test Procedure

The subjects were secured in the standard Cybex testing chair as shown in Figure 5, with the seat back angled at thirty degrees past vertical to provide a hip angle of approximately 120 degrees (6, 15, 23, 35, 72). A cross-the-shoulder racing car harness was utilized to secure the subjects upper torso to the seat back (Figure 5) and an eight centimeter wide strap (15, 28, 35) was secured across the distal one third of the right thigh. All practice and testing efforts were performed at an angular velocity of thirty degrees per second (28, 38). The resistance pad was secured just proximal to the ankle (Figure 6) with the strap below the bulk of the calf musculature (32, 35, 72). Positioning of the pad enabled each subject to still have full dorsiflexion and plan-

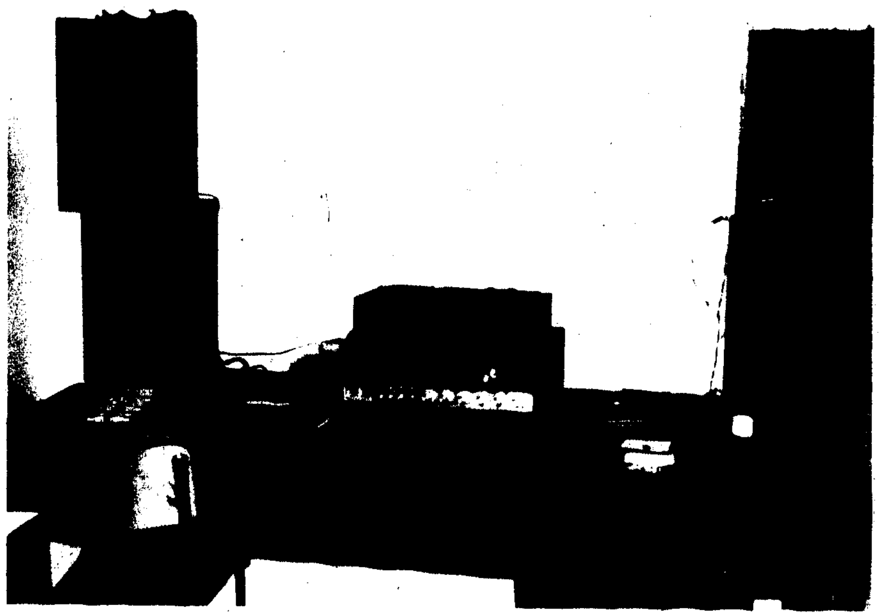

Figure 4. Sony Stereophonic Tape Player and Speakers

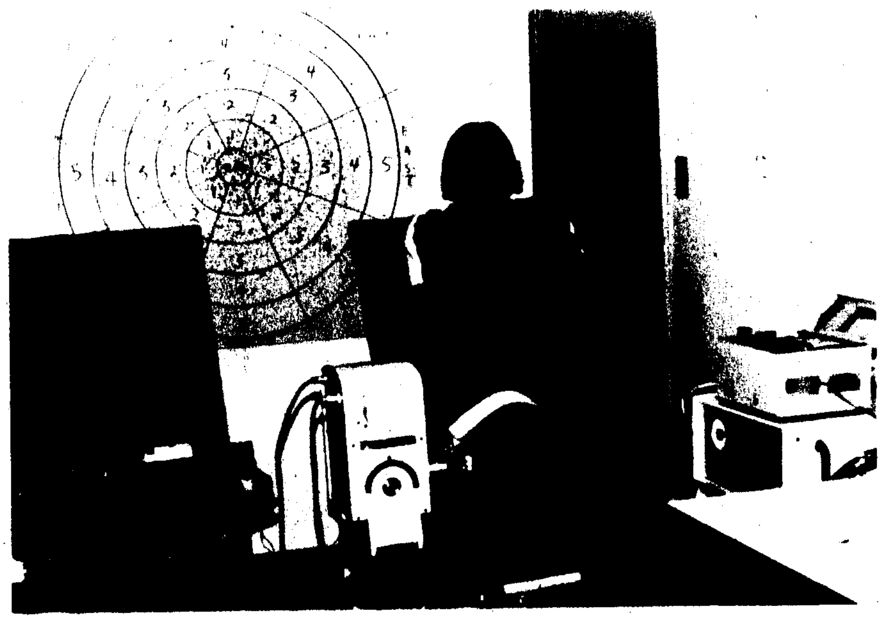

Figure 5. Cybex Testing Unit With Subject Secured

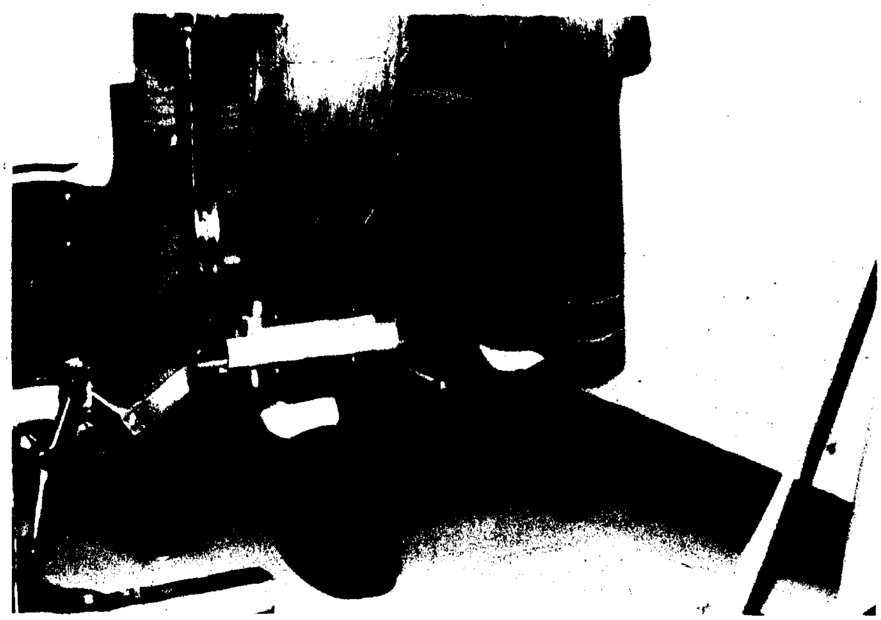

Figure 6. Right Leg Secured to Resistance Bar, Free Leg Restrained

tarflexion at the ankle. The left ankle was secured to the chair leg as shown in Figure 6. The subject completed the test with his arms crossed on his chest and his back remaining firmly against the back rest, as ensured by the torso harness (6, 32).

Prior to the standard test, a five minute familiarization period with the Cybex was allowed and the subjects completed a maximum of five submaximal practice efforts to serve as a rehearsal and a warm-up to the upcoming maximal effort test. The subjects were then given standard verbal instructions to perform three maximal effort knee extension efforts as quickly as possible (37, 72). The first retest group was the standard motivation group; the second retest group was the tape recorded, low verbal motivation group; the third retest group was the tape recorded, high verbal motivation group; the fourth retest group was the monetary motivation group; and the fifth retest group was the peer pressure motivation group (Figure 1).

All fifty subjects were retested three days after their initial test. Each subject within a group was examined in an identical environment and according to the criteria established for the group to which the subject was assigned. The subjects were tested a third time in an identical manner to which they were tested, the second time. This was done three days following the second test day (Figure 3).

The Cybex recorder was calibrated daily at thirty degrees per second using a twenty kilogram weight on a forty centimeter long force arm (Appendix B), and adjusted so that the isokinetic torque curve produced corresponded closely with the standard torque curve. This procedure is the one recommended by the Cybex Isokinetic Unit manufacturer.

The Statistical Analysis

Following the initial standardized test and random assignment of subjects to groups, a one-way analysis of variance was used to determine whether there was a statistically significant difference between the mean peak torques of the five groups (20).

The test mean of the standard group was compared with the pretest scores of the standard group.

The score from the two test situations for each group were averaged together to provide one criterion test score for each subject. This mean was used for comparison with the standard group which served as the control in the analysis of variance for each of the test situations.

A one-way analysis of variance and covariance with repeated measures was used to analyse the single test data. The BMDP IV Program (20) was the program used. A t-test that was within the BMDP IV Program was used to compare all group means with each other. In this method of data analysis, each group acted as its own control. Thus, the slight differences between the standard scores was eliminated from the experimental error. The data was tested at the .05 level of significance.

CHAPTER IV

RESULTS

The purpose of this study was to determine the effect of motivation on maximal torque output of the knee extensors on the Cybex Isokinetic Exercise Unit. A sample of fifty males between fifteen and nineteen years of age was examined.

Appendice D shows the group means observed for the five test groups.

Following random assignment of subjects into groups a one-way analysis of variance was used to compare the scores on the standardized situation (20). There was no statistically significant difference between the five groups at that time.

Table I shows the mean scores and standard deviations within each test group in the standardized test situation and the mean of the test situation.

Figure 7 shows the mean torque values and standard deviations within each group in the standard and the mean of the test situations.

Within the BMDP program, a comparison was made between the pretest scores of the standard group and the test mean of the standard group. This test showed no significant difference between those groups.

Table I. Mean Scores (ft.-lbs.) and Standard Deviations Within Each Test Group in the Standard and the Mean of the Test Situations. The figures in brackets indicate the standard deviation.

MOTIVATIONAL TYPES

	STANDARD	LOW VERBAL	HIGH VERBAL	MONEY	PEER	MARGINAL
CONTROL OR STANDARD MOTIVATIONAL SITUATION	124.5 (30.67)	127.8 (31.21)	128.9 (27.69)	124.4 (23.01)	123.1 (20.84)	125.6
MEAN OF TEST I & TEST II	124.75 (27.84)	126.69 (33.48)	132.33 (23.66)	135.10 (29.40)	136.45 (19.90)	131.22

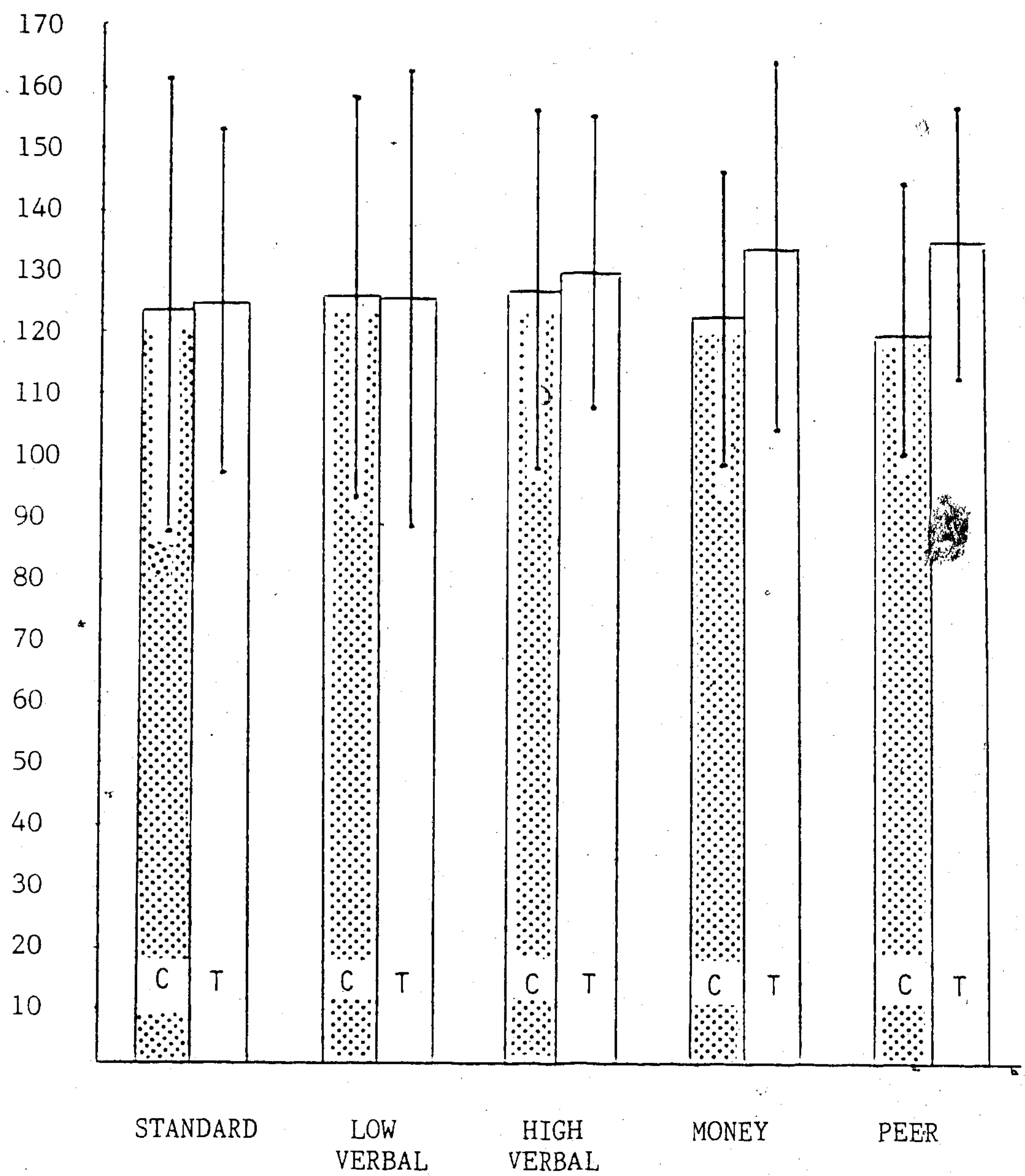

Figure 7. Mean Torque Values (ft.-lbs.) and Standard Deviations Within Each Group in Control (C) and the Two Test Situations. T is the average of Test 1 score and Test 2 score

The method used for the statistical analysis of the data was repeated measures of analysis of variance and covariance as specified in the 1981 BMDP IV Program (20). The control scores were used as a covariant in this data analysis.

Table II shows the probabilities for the t-values for the adjusted group means between the five groups.

A statistically significant difference was found between the peer pressure group and the standard group. The difference between the money motivation group and the standard approached statistical significance. The high tape-recorded verbal and the low tape-recorded verbal motivation showed no significant difference from the standard or control.

There was however, a statistically significant difference between the peer group and the low verbal motivation group. The money motivated group showed a statistically significant difference from the standard at the $P < .06$ level of significance.

Table II. Probabilities For the t-values For the Adjusted Group Means Between the Five Groups

	STANDARD	LOW VERBAL	HIGH VERBAL	MONEY	PEER
STANDARD	1.000				
LOW VERBAL	0.8670	1.000			
HIGH VERBAL	0.5061	0.4284	1.000		
MONEY	0.0570	0.0506	0.2248	1.000	
PEER	0.0196	0.0184	0.0991	0.6407	1.000

CHAPTER V

DISCUSSION

The purpose of this study was to determine the effect that various forms of motivation, both positive and negative, had on peak isokinetic torque forces at the knee joint as recorded by the Cybex II Isokinetic Exercise Unit.

It was shown in the results that based on the pretest scores, there was no significant difference between the five randomized groups. It was also shown that there was no significant difference between the pretest score of the standard group and the test mean of the standard group. Therefore the test means of the four test situation groups were compared with the standard mean.

The Tape-Recorded, Low Verbal Motivation Group

The torque values for knee extension that were recorded by the group that received tape-recorded, low verbal motivation did not vary significantly from the standard group. Since this form of low motivation did not significantly lower or change the strength scores, it will not be discussed as it related to the other groups.

Despite the fact that the low motivation group was treated in a way that lacked the enthusiasm of the high motivation test situation or even the standard test situation, strength scores were not significantly lower in this environment. The null hypothesis "there is no significant difference between the tape-recorded, low verbal, motivation situation and the standard situation", was not rejected.

This finding is in agreement with other studies that report that motivation has not been observed to be an important factor in the outcome of test scores in studies using motivation and strength testing (37, 69, 70, 84).

Schenck (70) and Jones (37) found that strength scores improved in the non-motivated and the motivated groups. These studies cited did not try to demotivate the subjects within the groups nor did they offer feedback or encouragement.

In the "demotivated" group in this study, the test situation was similar to the non-motivated environment in the Schenck (70) and Jones (37) studies. This fact may account for a similar lack of significant difference from the standard group.

Other, more subjective reasons for the lack of significant difference, could exist. Perhaps the demotivational environment, using only a five minute auditory stimulus was not truly demotivational. The excitement of being a part of an experiment and have scores recorded on a machine, may have provided a positive enough effect to outweigh the attempt at demotivation.

<u>The Tape-Recorded, High Verbal Motivation Group</u>

The group that was given tape-recorded, high verbal motivation was not significantly different from the standard (P=.5).

Despite the fact that there was high verbal motivation (in contrast to the lower verbal motivation of the previous group), the fact that it was tape recorded possibly made it less forceful and less stimulating and therefore almost paralleling the tape-recorded, low verbal motivated group. Comparing the results obtained with this group with the results obtained with the peer pressure group, it seems reasonable to assume that strength performance may have improved if the verbal motivation had been live. This fact may have served to reduce the psychologically induced inhibition to control the strength output and therefore may have given increased strength scores as suggested by Ikai et al. (33) and Wilmore (84).

However, the results of this test situation are in agreement with those found by Jones (37). Jones (37) found that encouragement by the experimentor did not have a significant effect on the strength performance of already highly motivated normal subjects. Schneck (70) also found that motivation in the form of information of previous results did nothing to increase strength performance measures.

The null hypothesis, "there is no significant difference between the tape recorded, high verbal motivation situation and the standard situation", was not rejected.

The Money Motivated Group

The group that was given money motivation did not vary significantly from the standard group. The probability for a difference was .057.

A subjective observation that was made during the testing of the individuals within the money group was that it appeared to be a large incentive to doing well. In a unique way, this strong tendency towards significance may support the hypothesis of Wilmore (84) and Ikai et al. (33), that the potential for immediate financial reward may be incentive enough to reduce a psychologically induced inhibition that would limit the strength output measures.

The null hypothesis, "there is no significant difference between the money motivation situation and the standard situation", was not rejected.

The Peer Pressure Motivation Group

The group that was given peer pressure for motivation did vary significantly from the standard.

This finding can be partially explained by the work done by Ikai and Steinhaus (33). These authors reported that the expression of human strength is generally limited by psychologically induced inhibition. The great stimulus offered by having five enthusiastic peers in the room might very well reduce inhibitions and allow an increased performance. Wilmore (84) supports Ikai et al. (33) in his hypothesis that anaerobic strength measurements may be increased if the motivating environment is enough to reduce the subject's inhibition towards maximal performance.

CHAPTER VI

SUMMARY, CONCLUSION AND RECOMMENDATIONS

It was hypothesized in this study that motivation would not vary the peak isokinetic strength performances of normal healthy subjects. In three of the four test groups, the null hypothesis was not rejected. Both high verbal and low verbal tape recorded motivation, and monetary motivation did not alter strength performance from the standard motivational situation. However, when the subjects being tested were surrounded by their peers, screaming encouragement, the strength performance of the individuals did significantly increase.

The theory proposed by Ikai and Steinhaus (33) on reducing inhibition to increase strength is supported in part by this study. The peer pressure motivational situation is considered by the author to have been the most stressful and thus the most effective at reducing inhibition.

In a follow-up study it would be recommended that the motivational situation become more extreme. Background noise or encouragement should be made much louder and more extreme. Financial motivation should be increased. These factors might influence the individual being tested enough to reduce their inhibition sufficiently to allow them to exert more force on an isokinetic strength test. It would be further recommended that the number of participants in each group be increased.

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APPENDIX A

INFORMATION TO POTENTIAL SUBJECTS

AND

INFORMED CONSENT FORM FOR RESEARCH STUDY

Information to Potential Subjects

The testing will be done during three sessions and will take about one hour for each subject. The sessions will be three days apart and will be at the same time each day.

If you agree to participate in this study you will be asked to perform no exercise other than walking for a least thirty minutes prior to the test.

When you arrive in the test room you will be asked to sit in the Cybex chair where you will have straps placed around your right ankle to connect you with the testing machine. You will be firmly secured in the chair by means of a race-car seat-belt harness and other restraining straps.

During the first test sequence you will be given a five minute familiarization period with the Cybex Unit. Tape recorded instructions will be played to you following the brief warm-up period. The remaining two test situations will be similar to the first familiarization test period. All instructions and encouragement will be played to you on a tape recorder.

Following the exercise session, you may find that the tested leg feels very weak and unstable. This sensation is only temporary and will disappear within two hours.

The purpose of this information is to assure that potential subjects understand the affects to which they will be exposed if they agree to participate in the study. If you have any questions, please discuss these with the investigator before you sign the Informed Consent Form.

Should you so choose, you may end your participation in this study at any time without being required to explain your reasons for withdrawal.

All personal information given to the investigator during this study will be regarded as confidential.

Informed Consent Form For Research Study

I, ______________________________, hereby give my consent to participate in a research study on the Cybex Isokinetic Exercise Unit, the general plan of which has been explained to me.

I fully understand as it has been explained to me that by notice given to the undersigned investigator--that I may withdraw from this research project any time that I may elect to do so.

____

Date   Participant's Signature

I hereby certify that I have given to the above individual an explanation of the contemplated study and any possible side effects.

____

Investigator's Signature

APPENDIX B

CALIBRATION CHART

AND

TECHNIQUE FOR THE STANDARDIZATION

OF THE

CYBEX II DYNAMOMETER

Calibration Chart - Isokinetic Apparatus

RECORDER SCALE SELECTOR	LEVER ARM Inches*	WEIGHT Pounds	CALIB. TORQUE INPUT Foot Pounds	GRAPH RECORDING PEAK
360	30	70	180	5 Major Divisions
180	31	32.5	90	5 Major Divisions
30	33	5	20	20 Major Divisions

CALIBRATION POINTS (mid-scale)

360 Scale *30" 70 lbs on arm yields 180 ft lbs (5 Major Divisions)

180 Scale *31" 32.5 lbs on arm yields 90 ft lbs (5 Major Divisions)

30 Scale *33" 5 lbs on arm yields 20 ft lbs (20 Major Divisions)

*Distance from center of CYBEX input shaft to center of T tube (lever arm length).

Procedure:

1. Select Recorder Range scale (0-30, 0-180 or 0-360).
2. With Speed Selector ON at 5 RPM and Recorder ON but no torque applied to input shaft:
   a) Select #4 position on Damping control.
   b) Select slow chart speed (2mm/sec).
   c) Align stylus with baseline of chart paper grid using Zero Adjust control.
   d) Check to see baseline does not shift when range scale is changed. Plus or minus small division of change on the 30 scale is acceptable. Baseline shift can be corrected by adjusting with a small screwdriver the potentiometer behind the cap marked ZERO on the vertical panel of the recorder case.
3. Attach proper amount of disc weights to T bar as per above calibration. Check accuracy of weights first as a 25 lb. weight may be off as much as 1/2 lb. from its indicated value. A 2 1/2 lb. weight may be off 1/4 lb. Use correct weight value.

4. Dynamic calibration is done by manually lifting weighted T bar to vertical position above dynamometer, then allowing it to swing down until weights contact the floor. As weighted arm passes the horizontal, it is applying the specified torque. The graph recording will show this value as the maximum point

on the curve. If this point is above or below the correct torque value, adjust the recorder and make it read the correct value by turning the appropriate (30, 180, 360) potentiometer behind the plug on the front of the case of the recorder using a small screwdriver. Turning the pot clockwise will decrease the reading and counterclockwise will increase it.

APPENDIX C

INSTRUCTIONS UTILIZED DURING TESTING

Standard Set of Instructions

"After the following brief instructions you will be given the command to begin. This test is the same as the trial you did last day. You are being asked to perform three all out knee straightening and knee bending movements done in rapid succession and as fast as possible. These movements are to be done through a full range of movement; that is, take your leg all the way out straight and then bend it back in under the table, three times.

Cross your arms on your chest;

Get ready;

Begin!

Harder !

Let's Go!

Last time!"

Tape Recorded, Low Verbal Motivation Instructions

"Following these instructions please begin. This test is the same as your first trial. Please do three successive knee straightening and knee bending routines.

Cross your arms on your chest and begin the repetitions whenever you are ready."

Tape Recorded, High Verbal Motivation Instructions

"After the following brief instructions you will be given the command to go. This test will involve the same three knee straightening and knee bending strength movements which you did in the standard test trial. You must repeat these three strength movements in rapid succession and the activity must be performed as fast as possible three times.

Cross your arms on your chest.

Get Ready! SET! GO!!!

PUSH HARD! PUSH HARD! PUSH HARD!

PULL BACK! PULL BACK!

HARD! HARD! HARD! KICK OUT!!

PUSH! PUSH! PUSH! PUSH! PUSH!

COMEBACK! COMEBACK! COMEBACK!

WORK HARDER!! WORK HARDER!!

LAST TIME!!

GO!! GO!! GO!! GO!! GO!!"

Money Motivation Instructions

"This test is the same as the trial you did last day. You are being asked to perform three all out knee straightening and knee bending movements done in rapid succession and as fast as possible. These movements are to be done through a full range of movement; that is, take your leg all the way out straight and then bend it back in under the table, three times.

This time, however, you will be encouraged with money. The harder you work, the more money you can make. For every tiny sequence on the graph paper that you can improve your score over your last test, you will be paid one dollar. The dollar bills on the table in front of you are yours if you can improve your previous trial score.

Cross your arms on your chest and begin whenever you are ready."

Peer Pressure Motivation Instructions

"After the following brief instructions you will be given the command to begin. This test is the same as the trial you did last day except that you will have some encouragement from some of the rest of your group. You are being asked to perform three all out knee straightening and knee bending movements done in rapid succession and as fast as possible. These movements are to be done through a full range of movement; that is, take your leg all the way out straight and then bend it back in under the table, three times.

Cross your arms on your chest; Get Ready; Begin!"

APPENDIX D

RAW SCORES FOR THE FIVE

GROUPS IN EACH TEST SITUATION

Peak Torque Values (ft.-lbs.) of Knee Extension in the Standardized Motivation Group

Subject Number	Standard Test	Motivational Test One	Motivational Retest Two	Motivational Mean
1	197	179	192	185.5
2	143	125	130	127.5
3	144	154	160	157.0
4	120	126	119	122.5
5	120	120	119	119.5
6	112	109	115	112
7	112	101	122	111.5
8	105	123	117	120
9	104	99	102	100.5
10	88	88	95	91.5
Mean	124.5	122.4	127.1	124.75
SD	30.67	27.07	28.61	27.54

Peak Torque Values (ft.-lbs.) of Knee Extension in the Tape Recorded, Low Verbal Motivation Group

Subject Number	Standard Test	Motivational Test One	Motivational Test Two	Motivational Mean
1	189	193	205	199
2	146	140	152	146
3	144	130	112	121
4	[redacted]	130	123	126.5
5	119	122	*	122
6	113	115	119	117
7	112	105	108	106.5
8	106	133	*	133
9	104	98	103	100.5
10	90	98	96	97
Mean	124.7	126.4	127.25	126.85
SD	28.43	27.71	35.68	29.37

* Subject Withdrew

Peak Torque Values (ft.-lbs.) of Knee Extension in the Tape Recorded, High Verbal Motivation Group

Subject Number	Standard Test	Motivational Test One	Motivational Test Two	Motivational Mean
1	188	168	160	164
2	150	174	150	162
3	144	136	156	146
4	128	138	131	134.5
5	120	118	120	119
6	112	117	114	115.5
7	110	110	122	116
8	105	93	98	95.5
9	103	134	143	138.5
10	98	106	*	106
Mean	125.8	129.4	132.67	129.7
SD	27.67	26.14	20.99	23.14

* Subject Withdrew

Peak Torque Values (ft.-lbs.) of Knee Extension in the

Money Motivation Group

Subject Number	Standard Test	Motivational Test One	Motivational Test Two	Motivational Mean
1	168	160	170	165
2	150	180	200	190
3	141	148	140	144
4	131	157	160	158.5
5	118	118	113	115.5
6	123	119	134	126.5
7	108	122	131	126.5
8	106	120	109	114.5
9	100	110	125	117.5
10	99	96	90	93
Mean	124.4	133	137.2	135.1
SD	23.01	26.56	32.24	29.01

Peer Torque Values (ft.-lbs.) of Knee Extension in the

Peer Pressure Group

Subject Number	Standard Test	Motivational Test One	Motivational Test Two	Motivational Mean
1	156	154	155	154.5
2	150	170	165	167.5
3	140	152	158	155
4	136	143	142	142.5
5	117	133	143	138
6	118	141	132	136.5
7	108	138	121	129.5
8	106	100	116	108
9	100	120	109	114.5
10	100	117	120	118.5
Mean	123.1	136.8	136.1	136.45
SD	20.84	20.36	19.43	19.25