ABSTRACT

Self-Selected Intensity, Repetitions, RPE and Adherence of Novice Female Weight Lifters During 6-Weeks of Resistance Training

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The purpose of this investigation was to determine what intensity novice female individuals would choose when allowed to self-select intensity when beginning a strength training program, the influence of efficacy beliefs and adherence. Fifty-three participants were randomly assigned to four groups based on weight type and instruction type and asked to record their self-selected intensities, repetitions and RPE in a public exercise facility for six-weeks. Results showed that the majority of participants exercised at an intensity that met commonly suggested guidelines (≥ 60% 1-RM) and that intensity did not differ between groups that received different instructions, although the potential for a one-repetition peak is discussed. Program attendance was not moderated by efficacy ratings. Lastly, significant correlations (at the 0.05 level) revealed that those with higher ratings of self-efficacy demonstrated greater adherence, while no significant correlation was found between the initial intensity chosen by individual participants and adherence.

Self-Selected Intensity, Repetitions, RPE and Adherence of Novice Female Weight Lifters During 6-Weeks of Resistance Training

by

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A Thesis

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

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Deo Gratias.

CHAPTER ONE

Introduction

Background

The prevalence of obesity, inactivity and subsequent hypokinetic diseases are of high priority, and of considerable public health importance (Colditz, 1999; Flegal, Carroll, Ogden & Johnson, 2002; Lind, Joens-maatre, & Ekkekakis, 2005; Poulton, Trvena, Reeder & Richards, 2002; Weinberg & Gould, 1995). Despite the concern for the growing epidemic of obesity, most individuals fail to adhere to exercise once they begin or return to a program (Annesi, 2000, 2004; Cunningham, Rechnitzer, Pearce, & Donner, 1982; Dishman, 1988, 1994b). Further, it has been shown that only 10-20% of individuals exercise with sufficient regularity to promote health benefits (Dishman, Farquhar, & Cureton, 1994; Klonoff, Annechilde, & Landrine, 1994). Exercise adherence deteriorates rapidly within the first few months for sedentary individuals, and it can be expected that 40-65% of individuals beginning or returning to an exercise program will drop out completely in 3 to 6 months (Annesi, 2004). The American College of Sports Medicine (ACSM) confirms that drop out rates can be as high as 87% of program participants, highlighting an adherence problem among those who voluntarily enter physical conditioning programs (American College of Sports Medicine [ACSM], 2000). As if these poor estimates of adherence were not enough, only 8-22% of adults participating in physical activity will do so at a sufficient intensity to satisfy conventional guidelines (Dishman, 1994a).

Conventional guidelines for resistance training protocols designed to elicit strength and/or hypertrophic gains can range from 60 to 85% of an individual's 1-repetition maximum (1-RM) (Glass & Stanton, 2004; National Academy of Sports Medicine [NASM], 2004; Baechle & Earle, 2000). Concern arises, again, as this recommendation of a relatively high intensity may cause exercise induced discomfort, thus leading to decreased adherence and higher drop out rates (see Annesi, 2000; Hashimoto, 2000; Poulton et al., 2002). It seems that if members of inactive populations select, or are prescribed, intensities that are perceived as very effortful, they may be less likely to continue in their participation (Dishman, 1994a). Those involved in activities involving strength and stamina may even judge their fatigue, aches and pains as signs of physical debility (Bandura, 1994). Whether or not individuals have preset tolerances for such exercise-induced demands, some behavioral modification programs are even seeking to bolster the ability to dissociate from exercise-induced discomfort (Annesi, 2004). While many conventional guidelines suggest maximal intervention of training variables, including intensity, for the training of athletic performance enhancement, some researchers such as Feigenbaum and Pollock (1997) as well as the ACSM (2000) suggest that these types of intense programs would not be beneficial for the average, sedentary adult beginning a strength training program. Thus, an intensity of 8 to 12 repetitions performed to the point of volitional fatigue has been recommended as more appropriate for beginning exercisers (ACSM, 2000). This recommendation, however, is based mostly on speculation rather than empirical data. Overall, little is known concerning the potential relationship between exercise intensity and resistance training program adherence.

While it is important to consider the physical intensity of exercise, it may also be important to consider the perceived intensity. In this regard, it has been shown that Ratings of Perceived Exertion (RPE) increase as exercise intensity increases (Gearhart, Goss, Lagally, Jakicic, Gallagher & Robertson, 2001; Lagally, Robertson, Gallagher, Gearhart & Goss, 2002; Sweet, Foster, McGuigan, & Brice, 2004). Perceived exertion is an individual's perception of exertion during physical work, and is considered one of the best indicators of the degree of physical strain (Borg, 1982). New or returning exercises interpret this exertion on their bodies as exercise-induced discomfort, and discomfort during exercise can negatively affect adherence (Annesi, 2004; Hashimoto, 2000; Weinburg & Gould, 1995). Individuals may judge such discomfort as signs of physical debility and avoid placing themselves in these situations where they feel they are likely to fail often (Bandura, 2004). With aerobic exercise, it may even be suggested that a lower intensity may actually improve exercise adherence, despite the proposed lack of optimal physiological adaptation (Cunningham et al., 1982; Lind et al., 2005). It seems that allowing for preferred or self-selected intensity of exercise may better promote exercise adherence (Cunningham et al., 1982; Dishman et al., 1994; Glass & Stanton, 2004).

Research has primarily examined self-selected intensities in aerobic exercise. Considering aerobic exercise, men seem to prefer an exertion around 60% of the VO_{2peak}, equaling an RPE of 9-12 (Buckworth & Dishman, 2002). Dishman and collegues (1994a, 1994) showed that individuals prefer RPE values ranging from 11-14, despite lower-active participants selecting lower absolute power outputs. Glass & Chvala (2001) found participants preferred an RPE of 12-13 or "somewhat hard" at 50-58% VO_{2max}. Mertesdorf & Schmidt (2005) and Lind et al. (2005) confirmed previous aerobic findings

showing that participants gravitate toward a level of intensity that approximates the level of transition from aerobic to anaerobic means or the lactate threshold. In general, aerobically based studies show that individuals will self-select an intensity that will meet commonly suggested guidelines for health benefits (Lind et al., 2005). Although, there is limited research relating specific intensities of aerobic exercise and adherence, it is suggested that lower-intensity exercise may increase adherence (Glass & Chvala, 2001; Dishman, 1994a). The same scarcity of research can be seen for resistance training.

To date, only one known study examining self-selected resistance training intensity has been conducted. In this study, Glass & Stanton (2004) examined 13 men and 17 women of college age (19.5 ± 1.85 yrs, 14.27% BF and 18.71 ± 1 yrs, 23.44% BF, respectively) who had no resistance training experience 6 months prior to the study. Participants were instructed on proper form and asked to perform 2 sets on Badger selectorized equipment. Each participant was asked to "choose a load that you feel will be sufficient to improve your muscular strength." Results showed that individuals, on average, completed 10 to 25 repetitions per set, reported a RPE of 12.6 to 13.6 (Borg's scale of 6-20), and selected a resistance equal to 40 to 60% of their 1-RM. The researchers concluded that the use of such self-selected intensities may be advantageous because of ease of use and its prospects for increasing exercise adherence (though adherence was not examined). A more strongly suggested disadvantage was the likelihood that participants would not choose a load intense enough to evoke strength/hypertrophy gains based on guidelines of the ACSM.

We should remember, however, that many individuals exercise not for performance benefit, but rather for health benefits. Considering the health benefits of

exercise, research suggests that some activity is better than none at all (Blair & Connelly, 1996). Thus, any method that can be employed to increase exercise program adherence is valuable. In this light, self-selected intensities deserve further examination. Also, despite the fact that individuals may self-select lower than recommended (for strength gains) intensities initially, it may be that they will adopt greater intensity with training experience. Bandura's (1994) self–efficacy theory would predict such an occurrence due to accumulation of progressive task mastery. Self-efficacy is an individual's belief in his/her capabilities to successfully execute necessary courses of action to satisfy situational demands (McAuley & Blissmer, 2000). Specific to exercise, Bandura (1994) describes perceived self-efficacy as people's beliefs about their capabilities to produce designated levels of performances. Self-efficacy has also been demonstrated as important in exercise choice, effort expended, and degree of persistence, in which continued persistence is synonymous with adherence (McAuley & Blissmer, 2000). The most effective way of creating a strong sense of efficacy or confidence in their abilities is through mastery experience (Bandura, 1986, 1994, 1997; Wise & Trunnell, 2001). Because mastery experiences are particularly influential on self-efficacy beliefs, it is of interest to see how self-selected intensities may change over time rather than simply examining the latter at only one time point and examining how self-efficacy beliefs may mediate changes in self-selected intensities. Based on Bandura's (1994) theorizing and previous research documenting the powerful effects of mastery experiences on self-efficacy beliefs and resultant behavior (Wise & Trunnel, 2001), it would be expected that, as beginning exercisers successfully engage in resistance training activities, their sense of self-efficacy should increase over time resulting in adoption of more challenging

intensities as well. There are no known studies that have investigated the effects of self-efficacy on self-selected intensities during resistance training.

The literature concerning prescription or self-selection of intensity in resistance exercise presents an interesting question. Is it preferable to prescribe conventional physiologically-based guidelines for resistance training and potentially reduce exercise adherence, or is it better to allow individuals to select their own intensity at the risk of inadequacy for physiologic adaptation? The answer to this question cannot presently be answered satisfactorily. First, it is not clear that intensity has a relation to resistance training adherence. Though the suggestion has been made that this is the case, no studies have directly addressed this question. In addition, we do not know whether preferred intensity would increase over time as individuals gain mastery experience associated with increases in self-efficacy. If this were the case, it would potentially negate Glass and Stanton's (2004) conclusion that self-selected resistance training intensities are not appropriate, as they are not intense enough to evoke strength gains. Also, Glass and Stanton's (2004) question to participants, "choose a load that you feel will be sufficient to improve your muscular strength" may be leading, as participants may choose a load amounts different from the amounts they would normally self-select in a naturalistic setting.

These questions become even more complicated as the majority of new or returning exercisers do not have the luxury of individually-based assistance from a trained professional. The majority of individuals tackle a myriad of behavioral, psychological and physiological stressors in their attempts to initiate and maintain exercise without proper instruction or prescription, and there is little information

concerning the intensities that untrained individuals will self-select when beginning a strength training regimen under naturalistic conditions. Likewise, little is known about how self-selected intensities may change as an individual gains mastery experiences over the course of a strength training program. Finally, research has generally not considered how self-selection of intensity may influence adherence to a weight training program.

Hypotheses

H_1: Participants will self-select an intensity at a level different from commonly suggested to elicit strength and hypertrophy gains.

H_2: Groups assigned to choose a load that is "comfortable" will self-select different intensities than those assigned to choose a load that they "should" to achieve strength gains.

H_3: Changes in self-efficacy ratings over time will be moderated by program attendance.

H_4: Changes in self-selected intensities over time will be moderated by self-efficacy beliefs.

H_5: Participants with higher ratings of self-efficacy will demonstrate greater adherence to the prescribed exercise program.

H_6: Participants adopting higher self-selected intensities relative to their percentage of 1-RM will demonstrate poorer adherence to the prescribed exercise program.

Statement of the Problem

The purpose of this investigation was to determine what intensity, repetition range and RPE healthy, untrained females would choose when allowed to self-select intensity when beginning a strength training program, and whether this may differ based on instructions to choose what they think they "should" vs. what is "comfortable." Secondarily, this research sought to determine how mastery experiences may influence

self-selected intensity by examining efficacy beliefs and self-chosen intensities over time. The final purpose of this investigation was to examine how self-selected intensities and mastery experience may relate to program adherence and dropout.

Limitations

The present investigation is limited in that the sample size may not be large enough to yield adequate statistical power to find significance if small effect sizes are observed. Also, to follow more of an applied research setting, participants will not receive an incentive to participate in the study, as to allow for adherence and/or drop-out. Finally, the present study may be limited by the generalizability of the results to the larger population of interest.

Definition of Terms

A. *Self-Selected Intensity* – the intensity of exercise chosen by the individual based on his or her own judgment or preferences.

B. *Preferred Exertion* – the exertion of a given exercise that is preferred by the individual, based on his or her own judgment.

C. *Borg's Ratings of Perceived Exertion (RPE*) – the intensity or exertion of exercise that is felt or perceived by the individual exercising. Typically, used on a scale from 6 to 20, where 6 is "no exertion at all" and 20 is "maximal exertion".

D. *Self-Efficacy* – People's beliefs about their capabilities to successfully accomplish a given task or goal.

E. *Mastery Experience* – The acquisition or the process of acquiring proficiency or mastery on a given task through personal experience.

CHAPTER TWO

Literature Review

Preferred Exertion, Resistance Exercise

Data regarding self-selected resistance training intensity is scarce. To date, only one study examining self-selected resistance training intensity has been found. In this one study, Glass and Stanton (2004) examined 13 men and 17 women of college age (19.5 ± 1.85 yrs, 14.27% BF and 18.71 ± 1 yrs, 23.44%BF, respectively) with no resistance training 6 months prior to the study. Participants were instructed on proper form, then asked to "choose a load that you feel will be sufficient to improve your muscular strength." All exercises were completed on Badger selectorized equipment. Each participant completed two sessions. Overall, results showed that individuals, on average, recorded 10-25 repetitions per set, at 40-60% of their initial 1-RM with a corresponding RPE of 12.6-13.6 (Borg's scale of 6-20). It was discussed by the researchers that self-selected intensities may be advantageous because of ease of use and its prospects for increasing exercise adherence. Despite these advantages, the prescribing exercise based on self-selected intensities was not suggested based on the apparent inability of the participants to choose a load intense enough to evoke strength and hypertrophy gains. In an abstract presentation, Glass and Stanton (1998) found that untrained females (18.7 ± 1.1 y) self-selected between 42.1 and 52.5% 1-RM. The researchers concluded that, since the load was less than suggested loads for improving muscular strength, self selection of lifting load is not an effective strength training methodology.

Unfortunately, the researchers did not explore preferred exertion in an applied setting, similar to the ones in which the population would be participating. Also, with two trials, there was the inability to test the effects that training and mastery experience may have on the intensity those individuals self-select. There is also the concern that a study should be done examining the effects of self-selected intensity with an untrained, sedentary overweight to obese (BMI $\geq$ 25) population without the mastery skills of previous resistance training. Finally, because of the impact exercise induced-discomfort may have on resistance training, a study is needed to explore how a self-selected intensity during resistance training and mastery experience affects exercise adherence.

Preferred Exertion, Aerobic Exercise

Despite limited research investigating self-selected intensities during resistance training, research as has already begun to self-selected intensities with aerobic exercise. Buckworth & Dishman (2002) reported that men prefer an exertion around 60% of the VO_{2peak}, equaling an RPE of 9 to 12. Dishman and collegues (1994a, 1994) also showed that individuals prefer RPE values ranging from 11 to 14, despite lower-active participants selecting lower absolute power outputs. Glass and Chvala (2001) found participants preferring an RPE of 12 to 13 or "somewhat hard" at 50 to 58% $VO_{2max,}$ which fall within the American College of Sports Medicine guidelines for aerobic exercise. Participants in this study chose preferred levels of exertion during three submaximal tests. Each participant completed the three respective tests on the treadmill, cycle ergometer, and the stair-stepper. Similar results were found when Farrell, Gates, Maksud, & Morgan (1982) compared trained male runners for a 30min run at a "freely chosen pace" to 30-min runs at fixed intensities of 60% and 80% of VO_{2peak}. The

preferred intensity was approximately 75%VO_{2peak} from 65-90% resulting in an average RPE of 9.2, compared to 8.8 and 12.3 for the 60% and 80% groups, respectively. Mertesdorf and Schmidt (2005) and Lind and colleagues (2005) confirmed previous aerobic findings with additional conclusions that participants gravitate toward a level of intensity that approximates the level of transition from aerobic to anaerobic means or the lactate threshold. Based on the findings of self-selected intensities during aerobic exercise, individuals are capable of self-selecting intensities that meet commonly suggested guidelines prescribed for health benefits.

Strength/Resistance Training

Muscular fitness is a component that should be included in most, if not all exercise regimens. Resistance training can increase or maintain fat free mass (FFM), resting metabolic rate (RMR), or bone mass to help prevent osteoporosis, aid in glucose tolerance and prevention of non-insulin dependent diabetes mellitus (NIDDM), promotes musculotendinous integrity, increase the ability to carry out the activities of daily living (ADL), and promote self-esteem (American College of Sports Medicine [ACSM], 2000). Resistance training is also well accepted as an effective means for improving athletic performance and quality of life (Sweet et al., 2004). The area of quality of life is of extreme importance as senior citizens become the fastest growing segment of our population. As loss in muscle mass appears to be the major cause of strength decrease in the elderly (Rogers & Evans, 1993), resistance exercise can rectify many of the health problems and physical deterioration incurred with aging (Arent, Landers, & Etnier, 2000).

Santana (2000) agrees that muscular strength is the quintessential quality most sought after, and that the main objective of general strength is to create anatomical adaptations geared towards increasing maximum strength and work volume. But, it is unclear as to whether individuals self-select a high enough intensity to accomplish these physiological gains. Conventional guidelines for strength and hypertrophy gains range from 60% to ≥ 85% of a 1 repetition maximum (1-RM) (Baechle & Earle, 2000; Glass & Stanton, 2004; National Academy of Sports Medicine [NASM], 2004). The beginning exerciser, similar to the individuals in the present study, is given the recommendation to exercise 2 to 3 times per week, 8 to 12 repetition maximum (RM) to the point of volitional fatigue, and one set per exercise of a suggested 8 to 10 exercises following ACSM guidelines (ACSM, 2000). These specific recommendations are specifically designed for the apparently healthy, sedentary individual just beginning a strength training program. Table 1 provides an overview of conventional strength training guidelines.

Table 1

Strength Training Guidelines

	Training Variables				
	Intensity	Sets	Repetitions	Rest	Frequency
ACSM	8-12 RM*	≥1	8-12		2-3 $d \cdot wk^{-1}$
NSCA	≥85% 1-RM	3-6	6-12	30s – 1.5m	2-3 $d \cdot wk^{-1}$
NASM	70-100% 1-RM	1-11	1-12	45s – 5m	3-5 $d \cdot wk^{-1}$

Note. RM = Repetition maximum; 1-RM – 1 Repetition maximum. Adapted from ACSM (2000), Baechle & Earle (2000), & NASM (2004)

*Based on volitional fatigue, but suggest higher-intensity effort at or near maximal effort will produce a significantly greater effect in strength development.

Further, a 3 RM is equal to approximately 85% 1-RM, while the best strength gains are also seen from resistances yielding 4 to 6 RM (Feigenbaum & Pollock, 1997). As many conventional guidelines suggest maximal intervention of training variables, including intensity, for the training of athletic performance enhancement, Feigenbaum and Pollock (1997) and the ACSM (2000) suggest that these types of intense programs would not be beneficial to the average, sedentary adult. Thus, the guidelines of the ACSM may seem minimal when compared to other guidelines, but are thought to be optimal for the sedentary individual beginning a strength training program who is at risk of drop-out or for those who do not desire to attain the highest levels of strength (Feigenbaum & Pollock, 1997).

Ratings of Perceived Exertion (RPE)

When dealing with self-selected intensities, individuals who are at risk for dropout may or may not choose intensities based on their perceived exertion. Borg (1982) found that high correlations existed (0.80-0.90) between heart rate and ratings of perceived exertion (RPE) levels during aerobic exercise on the scale of 6 to 20. Several studies have aimed to confirm these correlations during resistance training. RPE has been shown to increase as the intensity of resistance training increases (Gearhart et al., 2001; Lagally et al., 2002, 2004; Sweet et al., 2005). Electromyographic activity has also been shown to increase with increasing intensity and RPE (Lagally et al., 2002, 2004; Sweet et al., 2005). Gearhart, et al. (2001) recorded an RPE of 8-10 at 30% 1-RM and RPE of 14-15 at 90% 1-RM. Lagally et al. (2004) recorded an RPE of overall body (RPE-O) of 11.29 ± 1.65 at 60% 1-RM and an RPE-O of 13.39 ±1.89 at 80% 1-RM, showing RPE to be a good measure of strength exertion. Finally, Sweet et al. (2004)

showed an increase in RPE (1-10 scale) from 3.8 ± 1.6 to 5.7 ± 1.7 to 6.3 ± 1.4 as the %1-RM increased from 50% to 70% to 90%, respectively.

Exercise Induced Discomfort & the Ability to Tolerate Discomfort

Intensity and exertion also tend to play an important role in exercise adherence. Hashimoto (2000) states that feeling comfortable during exercise is extremely important to achieve regular participation in exercise, and that self-established intensities are likely to make daily exercise more enjoyable and possibly promote regular participation in exercise. Discomfort during exercise has been shown by others to affect exercise adherence (Annesi, 2004; Weinberg & Gould, 1995). Individuals involved in activities requiring strength and stamina seem to judge their fatigue, aches and pains as signs of physical debility (Bandura, 1994). The idea of exercise-induced discomfort is of such importance, Annesi (2004) suggests that behavioral directed modification programs should seek to bolster individuals' ability to dissociate from it.

Exercise Adherence

Despite the growing concern for obesity and inactivity, adherence to exercise proves to be a major area of focus for exercise scientists. Annesi (2004) showed that 40 to 65% of those either initiating or returning after relapse will drop out from their exercise program, if the program contains no behaviorally based coaching designed to promote adherence. Dishman and colleagues (1994) and Weinberg & Gould (1995) confirm that at least 50% of individuals will drop out after the first six months of engagement in an exercise program. The American College of Sports Medicine (2000) highlights the same compliance problem among those individuals whom voluntarily enter

physical conditioning programs, as dropout rates may increase up to 87%. Even for the individuals who do exercise regularly, only approximately 20% exercise with sufficient regularity to achieve optimal health benefits. If the goal of public health and exercise promotion is to provide health benefits to the participants, then compliance to exercise through lifetime adherence becomes a crucial point of focus.

Self-Efficacy/Mastery Experience

Based on the poor program adherence documented in the literature, we might then ask what do consistent exercisers possess that non-compliant exercisers do not possess? One of the primary findings related to this question can be found in that individuals who adhere to exercise have been shown to be self-efficacious. Self-efficacy is an individual's belief in his/her capabilities to successfully execute necessary courses of action to satisfy situational demands (McAuley & Blissmer, 2000). Specific to exercise, Bandura (1994) describes perceived self-efficacy as people's beliefs about their capabilities to produce designated levels of performances, which will in turn determine how people feel, think, motivate themselves and behave. It appears that the more efficacious an individual is the greater their participation in physical activity will be (Dzewaltowski, 1994). This efficacy is important, specifically in resistance training exercise that involves a higher level of skill than a beginning exerciser may be used to. If an individual does not feel efficacious with their exercise program, adherence to that program may be negatively affected. McAuley and Blissmer (2000) state that self-efficacy has been shown to be a significant predictor of exercise adherence. One could then assume that the greater one's efficacy in their own ability, the greater adherence to a weight training program. Self-efficacy may also factor into what types of exercises an

individual will choose (McAuley & Blissmer, 2000). Individuals may feel more efficacious with a certain mode of exercise, such as machine weights, and thus gravitate toward their use. In a novice population, it would seem that insufficient efficacy would limit what exercises they participate in, potentially limiting the maximum positive effects and adaptations of weight training. For instance, if the self-efficacy of an individual limited him/her to a set of exercises, one of the only variables to change for continued musculoskeletal adaptations is effort of intensity self-selected. Self-efficacy has been demonstrated as important in effort expended and degree of persistence, in which continued persistence is synonymous with adherence (McAuley & Blissmer, 2000). It is unclear whether or not self-efficacy increases over time will actually alter the degree of persistence and effort enough to affect the amount of weight an individual will self-select.

To investigate how self-efficacy affects self-selected intensities, the development of self-efficacy must be addressed. The most effective way of creating a strong sense of efficacy or confidence in their abilities is through mastery experience (Bandura, 1986, 1994, 1997). Mastery experience can be seen as the acquisition or the process of acquiring proficiency or master on a given task through personal experience. In other words, the more an individual weight trains with a particular exercise the more proficient that they will become. This proficiency will then create a strong sense of efficacy within the individual. Again, this efficacy may be strong enough to promote increased adherence in weight training. Of present interest, will changes in self-efficacy over time affect adherence as well as the amount of resistance that novice weight lifters will self-select? Based on Bandura's (1994) theorizing and previous research documenting the powerful effects of mastery experiences on self-efficacy beliefs and resultant behavior

(Wise & Trunnel, 2001), it would be expected that, as beginning exercisers successfully engage in resistance training activities, their sense of self-efficacy should increase over time resulting in adoption of more challenging intensities as well. Bandura (1994) continues to say that building efficacy requires avoiding placing people in situations prematurely where they are likely to fail often, and they should measure success in terms of self-improvement. Finally, those who maintain a resilient sense of efficacy set themselves challenging goals.

Conclusion

Self-selected intensities may play an important role in increasing exercise adherence. This role is important as aerobic and resistance exercise promote benefits in health and function in all populations, including sedentary individuals. It has been shown, in general, that individuals will self-select an intensity during aerobic exercise that will meet common exercise prescriptions. Unfortunately, there is limited research examining the preferred exertion during resistance training, but it appears that individuals do not self-select intensities for common resistance exercise prescriptions designed to enhance muscular strength and hypertrophy. No studies have examined self-selected resistance training intensities over time. Given time, there may be significant changes in self-efficacy that may allow for increased amounts of preferred exertion, but no studies have examined self-efficacy changes over time in relation to resistance training. It would be expected that, as beginning exercisers successfully engage in resistance training, their sense of self-efficacy should increase over time resulting in adoption of more challenging intensities, thus improving the opportunity for adherence.

CHAPTER THREE

Methodology

Participants

Fifty-three healthy, sedentary females with minimal to no past resistance training experience were recruited for the present study. The majority of participants were recruited from non-major human performance classes at Baylor University. Eligible participants had not resistance trained in at least the past two years. The average age, weight, height and BMI for participants equaled 19.54 ± 0.88 yrs, 141 ± 22.27 lbs, 64.38 ± 3.57 in, 24.03 ± 3.90 BMI, respectively. Fifty-three participants began the study, with only four engaging in weight training through week six. Two subjects had to drop-out during the study due to injuries obtained outside of the study.

Participants received only a small incentive (T-shirt) at the beginning of the study to ensure that the incentive did not affect adherence in the study. Participants provided signed consent in accordance with the University's Institutional Review Board (IRB), and complete a health questionnaire to ensure that all participants were healthy, being free from any chronic health conditions. Height, Weight and BMI were measured for all participants. Upon giving consent, participants were assigned to one of four treatment conditions, using a randomized block assignment. Groups 1 (n = 13) and 3 (n = 13) were assigned to engage in six machine exercises (chest press, shoulder press, back pulldown, biceps curl, triceps extension and leg press) where they were allowed to self-select their own intensity and repetition range. Groups 2 (n = 14) and 4 (n = 13) were assigned to engage in six free weight exercises (chest press, shoulder press, back

pulldown, biceps curl, triceps extension and leg press) where they were allowed to self-select their own intensity and repetition range. To investigate the potential of leading with self-selected intensities, groups were separated by two different sets of instructions. Both group 1 and group 2 were asked to *"select a load that you feel you should to improve your muscular strength"* for the duration of the study, while groups 3 and 4 were asked to *"select a load that is comfortable"* for the duration of the study, thus creating a 2 x 2 (Weight Type x Instructions) factorial design.

Measures

Rating of Perceived Exertion (RPE). Borg's RPE Scale (Borg, 1982) is a 15-point rating based on a self-report, psychophysical measure of perceived effort. The scale ranges from 6 to 20, where 6 represents a rating of *very, very, light* and 20 represents a perception of *very, very hard or maximal* exertion. This measure was originally designed for aerobic exercise measures, but has been validated for use during resistance training (Lagally et al., 2004).

One-Repetition Maximum (1-RM). The standard for dynamic strength testing is the 1-RM, which is the heaviest weight that can be lifted only once using good form. The 1-RM protocol will follow the American College of Sports Medicine's (ACSM, 2000) guidelines (see appendix) for each of the respective machine or free-weight exercises.

Self-Efficacy. To measure beliefs concerning the ability to successfully engage in bouts of resistance exercise, a scale was developed following Bandura's (2005) recommendations for developing efficacy measures. In this respect, Bandura recommends: a) creating domain-specific items specific to the area of interest, b) the creation of scales that present different levels of task demands, and c) use of a scale

ranging from 0 to 100 in 10-point intervals. Based on these guidelines and examination of measures employed in exercise settings to examine self-efficacy (e.g., McAuley, 1993; Rodgers & Gauvin, 1998; Treasure & Newbery, 1998) a 14-item self-efficacy measure was developed (see appendix). This scale was designed to measure confidence in one's ability to perform the weight lifting exercises employed in the present investigation at 14 levels of resistance. Participants will be asked to rate their confidence to perform "most of the lifts/exercises in the prescribed program" at different levels of resistance (ranging from 5 lbs to 200 lbs) at the beginning study, at the end of each week and at the end of the study.

Procedures

Each participant, after giving consent, began the study by completing a health questionnaire, contact information sheet, and self-efficacy questionnaire. At the end of each week, participants filled out additional self-efficacy questionnaires via email contact. The questionnaires were designed to reveal if self-efficacy beliefs affected the participants' self-selected intensity and repetition range, as well as potential effects of increased mastery experience of the resistance training modalities over time.

Before the first exercise session and after self-efficacy measures had been taken, each participant also received an initial 1-RM on each exercise in her respective group, machine or free weight. The 1-RMs were performed based on the guidelines of the American College of Sports Medicine (2000). The participants were then told to perform one set of the self-selected intensity and repetition range three times a week, for 6 weeks. Each exercise was performed in the order that was provided on the workout log (chest press, shoulder press, triceps extension, back pulldown, biceps curl, leg press). For each

workout session, each participant recorded her self-selected intensity, number of repetitions and RPE for each of the six exercises for the respective group (Figure 1).

Date: _____

Select a load that is comfortable

	EXERCISE MACHINE	WT	REPS	RPE
1	Chest Press			6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
2	Shoulder Press			6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
3	Triceps Extension			6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
4	Back Pulldown			6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
5	Biceps Curl			6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
6	Leg Press			6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
RPE SCALE: 6=no effort; 11=light; 13=mod. Hard; 15=hard; 17=very hard; 20=max effort				

Figure 1. Example workout session sheet – Group 3

Note. WT = Weight, REPS = Repetitions, RPE = Ratings of perceived exertion

Each participant performed these workouts in a public exercise facility, in order to provide a naturalistic setting. Each participant was asked to abide by all rules of the exercise facility to help ensure the safety of each participant. All efforts were recorded in the workout logs provided for them at the exercise facility. At the end of each workout the participant's recorded workout was removed, so to not inhibit or persuade what she would self-select in the following exercise session. All workout logs were picked up and left in the exercise facility by the participants. Each workout log was coordinated by group, and specifically identified to each participant by the last six digits of her social security number. After six weeks of study participation, each participant that adhered concluded the study by performing a final 1-RM on each respective exercise.

Statistical Analysis

The present investigation sought to examine three distinct sets of relationships. Specifically, this research sought to understand: a) levels of self-selected intensities relative to common "guidelines," how self-selected intensities may differ based upon the instructions given to participants, and whether such differences may be influenced by the type of resistance training (i.e., free or machine weights), b) how self-selected intensities may change over time and the degree to which self-efficacy beliefs may mediate these changes for the two types of resistance training, and c) whether self-selected intensity may relate to program adherence. Each of these questions demanded a different analytical approach, as described below. For all analyses, the alpha criterion for determining significance was set at .05.

Concerning the level of self-selected intensities in relation to common guidelines (Hypothesis 1), mean values and two-sided confidence intervals were constructed to compare number of repetitions and percentage of 1-RM to common (e.g., ACSM) guidelines. In order to examine how instructions designed to guide participants to self-select intensity on the basis of what they "should" choose to achieve strength gains vs. choosing a load that is "comfortable" (Hypothesis 2), a 2 x 2 (Instructions by Weight Type) MANOVA was conducted using number of repetitions, RPE, and percentage of 1-RM as the dependent measures for the first recorded exercise session. Any significant omnibus multivariate main effect or interaction were followed-up by univariate tests to determine which dependent measures were contributing to the multivariate effect(s).

To examine whether self-selected intensities change over time differentially by treatment condition, a 2 x 2 x 2 (Instructions by Weight Type by Week) Repeated

Measures MANOVA was conducted on the dependent measures of number of repetitions, RPE, and percentage of 1-RM. 2-weeks (Week 6 and Week 1), were utilized as the two time points to examine the changes over the entire 6-weeks. As before, any significant omnibus multivariate main effect or interactions permitted univariate follow-up tests to determine which dependent measures were contributing to the multivariate effect(s).

To determine whether changes in self-efficacy ratings over time were moderated by program attendance (Hypothesis 3), regression analysis was conducted following the procedures described by Baron & Kenney (1986). Group differences were ignored in these analyses to achieve an acceptable cases-to-independent variable ratio (see Tabachnik & Fidell, 1996). In order to test for moderation, multiple regression analysis was performed by regressing Week 6 self-efficacy on Week 1 self-efficacy, frequency of exercise sessions over the 6 week exercise program, and the Week 1 self-efficacy by frequency of attendance interaction. If the interaction term resulted in a significant effect, simple regression slopes (following procedures described by Aiken & West, 1991) were computed to determine the nature of the interaction.

To determine whether changes in intensity over time are moderated by self-efficacy beliefs (Hypothesis 4), multiple regression analysis were conducted following the procedures described by Baron & Kenney (1986). Group differences will be ignored in these analyses to achieve an acceptable cases-to-independent variable ratio (see Tabachnik & Fidell, 1996). In order to test for moderation, multiple regression analysis were performed by regressing Week 6 intensity (% of 1-RM) on Week 1 intensity (% of 1-RM), change in self-efficacy scores from Week 1 to Week 6, and the Week 1 intensity by self-efficacy change interaction. If the interaction term results in a significant effect,

simple regression slopes (following procedures described by Aiken & West, 1991) were computed to determine the nature of the interaction.

To determine whether self-efficacy beliefs or self-selected intensities relate to adherence (Hypotheses 5 and 6), correlations between mean levels of self-efficacy beliefs over the 6 Week program and frequency of attendance, and between first session self-selected intensity (percentage of 1-RM) and frequency of attendance will be computed. Treatment group will not be considered in these analyses to attain acceptable statistical power.

CHAPTER FOUR

Results

Self-Selected Intensities

To examine whether or not participants would self-select intensities different than commonly suggested guidelines to elicit strength and hypertrophy gains (≥ 60% 1-RM) (Hypothesis 1), mean values were computed and two-sided confidence intervals were calculated for the self-selected intensity (% 1-RM) for the first session. Table 2 and Figure 2 show the mean values of intensity for each of the respective treatment conditions (Table 2) on specific exercises. Means and confidence intervals are illustrated across weight type and instruction type in Table 3. Significant differences in 1-RM were not found between group means based on weight type. Although, when accounting for the 1-RM of individual exercises, significant differences were found between machines and free weight groups on triceps extension, back pulldown and leg press, $p < 0.01$. Over all six exercises for all subjects, the mean self-selected intensity was 60.12% ± 12.03%. A majority (~73.91%) of the participants chose an intensity ≥ 60% 1-RM, with Group 3 (machine, "comfortable") being the only group to self-select a lower mean (57.65% ± 8.75%), though confidence intervals still included 60% 1-RM.

Table 2

Mean Self-Selected Intensity between Groups (%1-RM)

Variable	Should		Comfortable	
	Machine	Free-weight	Machine	Free-weight
Mean	59.58%	63.66%	57.65%	60.15%
SD	18.04%	8.32%	8.75%	11.54%

Table 3

Mean Self-Selected Intensity (%1-RM) and Confidence Intervals

Variable	Machine	Free-weight	Comfortable	Should
Mean	56.80%	61.30%	60.70%	57.50%
95% C.I.	51.7% - 62.0%	56.1% - 66.5%	55.3% - 66.1%	52.5% - 62.4%

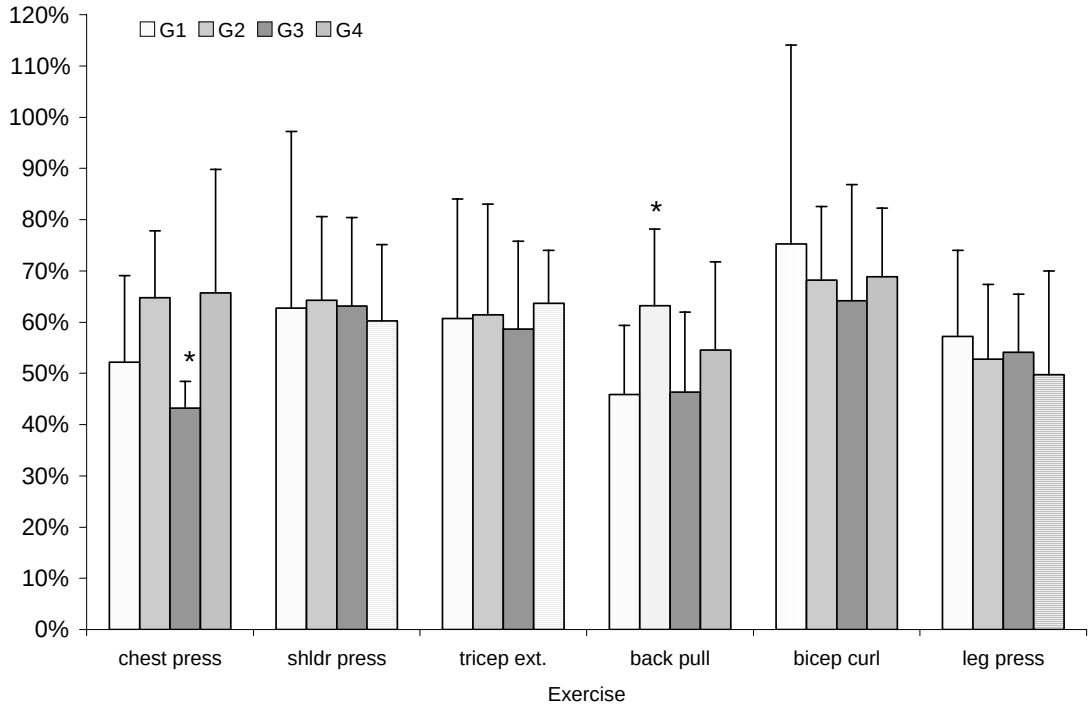

Figure 2. Self-selected intensity (% 1-RM) for each exercise at the first session.

Note. * $p < 0.05$

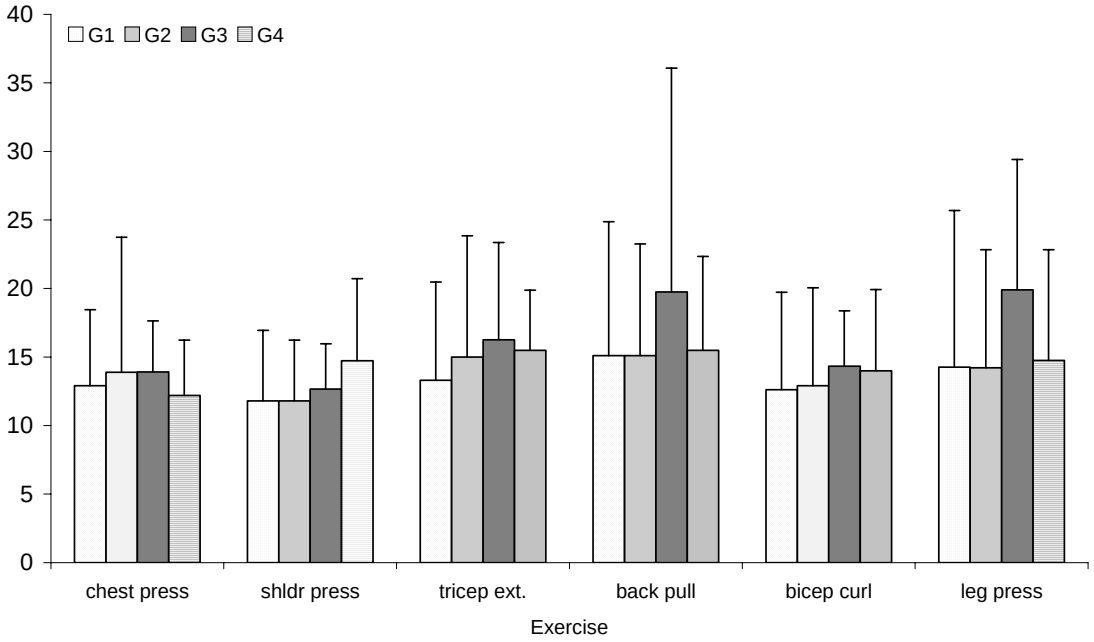

Figure 3. Self-selected repetitions for the first session.

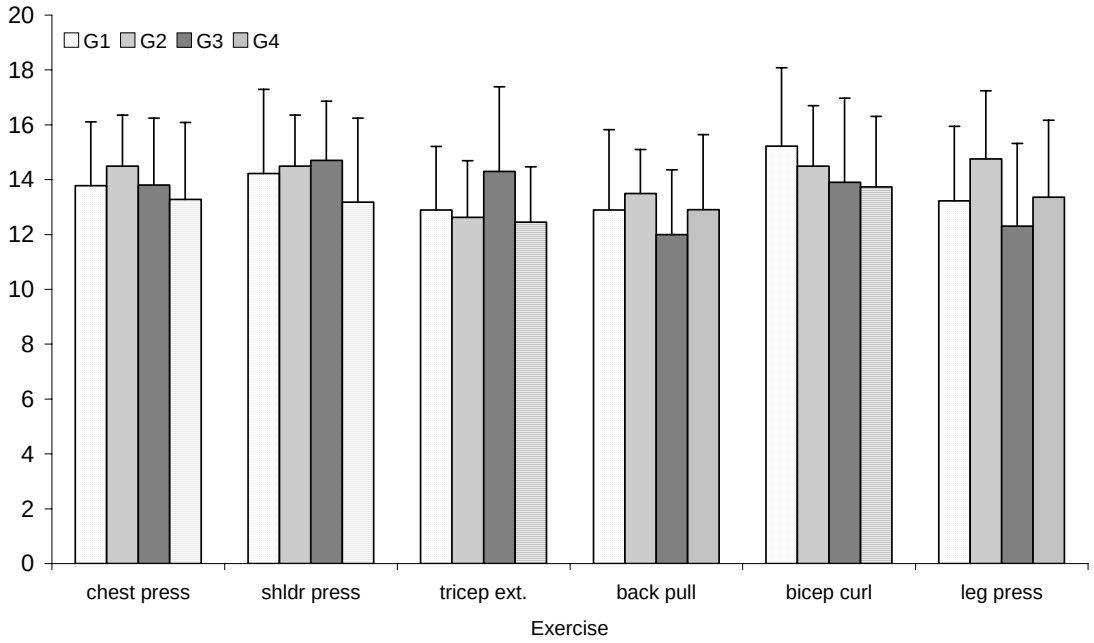

Figure 4. Ratings of perceived exertion (RPE) for the first session.

Instructions and Weight Type

To examine whether groups assigned to choose a load that was "comfortable" would self-select a different intensity than those assigned to choose a load that they "should" to achieve strength gain (Hypothesis 2), three sets of 2 x 2 MANOVAs (Instructions x Weight Type) were utilized using the six different lifts' intensities (% 1-RM), repetitions and RPE's, respectively as the dependent variables. Examining the results for % 1-RM, there was a significant multivariate main effect for weight type, Wilks' Lamda = 0.653, $F(6, 31) = 2.75$, $p < .05$. Neither the instruction, Wilks' Lamda = 0.934, $F(6, 31) = 0.367$, nor the weight type by instruction interaction, Wilks' Lamda = 0.893, $F(6, 31) = 0.621$, were significant ($p > .10$). Examining the results of univariate follow-up tests to determine which dependent variables contributed to the multivariate weight type effect, there were significant effects for chest press, $F(1, 36) = 9.899$, $p < .01$, and back pulldown, $F(1, 36) = 6.879$, $p < .05$. There were no significant effects for any of the other four lifts ($p > .10$). Mean self-selected intensities by weight type and instruction type are summarized in both Table 2 and Figure 5. Mean "Should" and "Comfortable" group intensities (% 1-RM) were 60.61% ± 14.11% and 57.58% ± 10.30%, respectively. Mean machine and free weight group intensities (% 1-RM) were 56.75% ± 13.88% and 61.30% ± 9.93%, respectively. Figure 3 and Figure 4 illustrate self-selected repetitions and RPE.

Examining the results of 2 x 2 MANOVA for the six lift types for RPE, there was not a significant weight type, Wilks' Lambda = $F(6, 29) = 0.833$, $p > .10$, or instruction main effect, Wilks' Lambda = $F(6, 29) = 0.812$, $p > .10$, or interaction, Wilks' Lambda = $F(6, 29) = 0.815$, $p > .10$. Similarly, the results of 2 x 2 MANOVA for the six lift types

for repetitions showed there was not a significant weight type, Wilks' Lambda = $F(6, 29) = 0.804$, $p > .10$, or instruction main effect, Wilks' Lambda = $F(6, 29) = 0.807$, $p > .10$, or interaction, Wilks' Lambda = $F(6, 29) = 0.860$, $p > .10$.

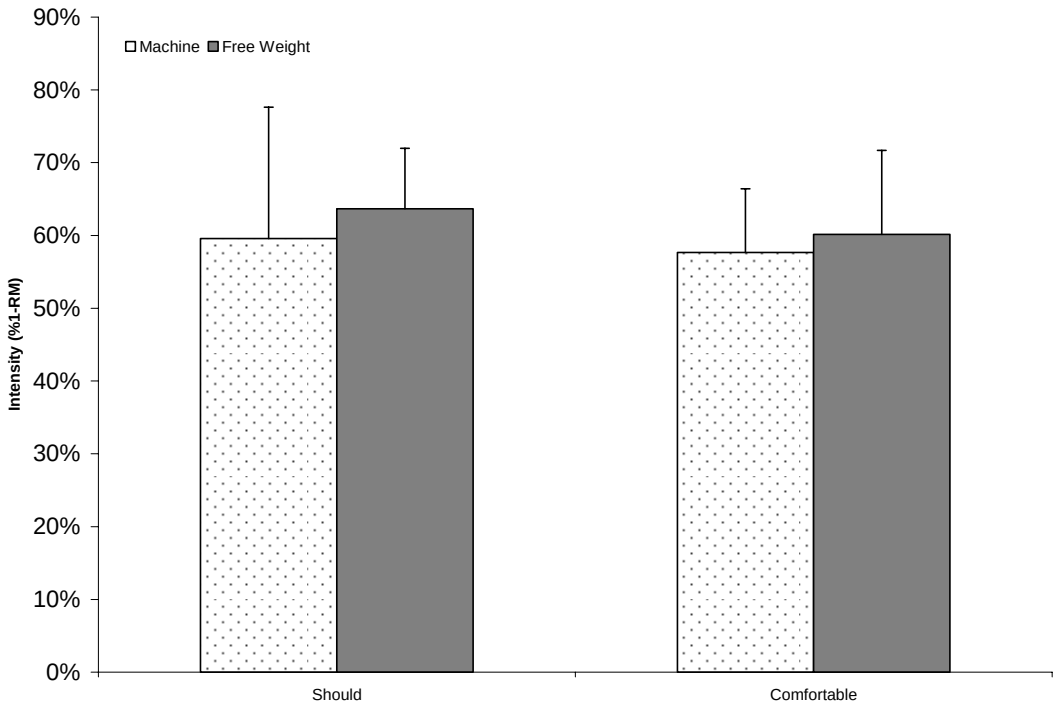

Figure 5. Self-selected intensity (% 1-RM) by instruction type.

Changes in Self-Efficacy

Multiple Regression analyses were performed to investigate whether or not changes in self-efficacy ratings (SE) over time would be moderated by program attendance or frequency following procedures of Baron and Kenny (1986). To test for moderation, the interaction of SE change over the 6 weeks with attendance must be significant. Regression was performed using Week 6 SE as the criterion variable and Week 1 SE, frequency of attendance, and the Week 1 SE by attendance interaction as

predictor variables. If the interaction term is significant, moderation is said to have occurred (Baron & Kenny, 1986). The regression model was significant, $F(3, 22) = 4.675$, $p < .05$, and the variance accounted for by the three predictor variables equaled 38.9% (Adj. $R^2 = .306$). Examination of individual beta coefficients, however, failed to demonstrate significant effects for any of the predictor variables, $t < .87$, $p > .10$. It should be noted, however, that there was a significant, $t(25) = -3.311$, $p < .01$, mean increase in SE ratings from week 1 (57.74 ± 9.75) to Week 6 (63.90 ± 11.36). Significant correlations existed between Week 6 SE and Week 1 SE ($r = .606$, $p < .01$), while the correlations between frequency and Week 1 SE ($r = -.172$, $p > .10$) and frequency and Week 6 SE ($r = -.002$, $p > .10$) were not significant.

Self-Efficacy and Adherence

Correlation analysis was utilized to investigate a potential relationship between mean weekly SE ratings and frequency of attendance. This correlation tested Hypothesis 5, which stated that participants with higher ratings of self-efficacy will demonstrate greater adherence to the prescribed exercise program. Mean values of the six weekly SE means and frequency of attendance can be seen in Table 4, while Figure 6 illustrates the overall attrition rate for participants in the study. A significant correlation ($r = .292$) at the 0.05 level (two-tailed) was found between the mean of weekly SE ratings and frequency of attendance.

Table 4

Mean Weekly Self-Efficacy and Frequency

Variables	Mean	SD
6 weekly SE means	58.72	8.91
Frequency	7.08	5.53

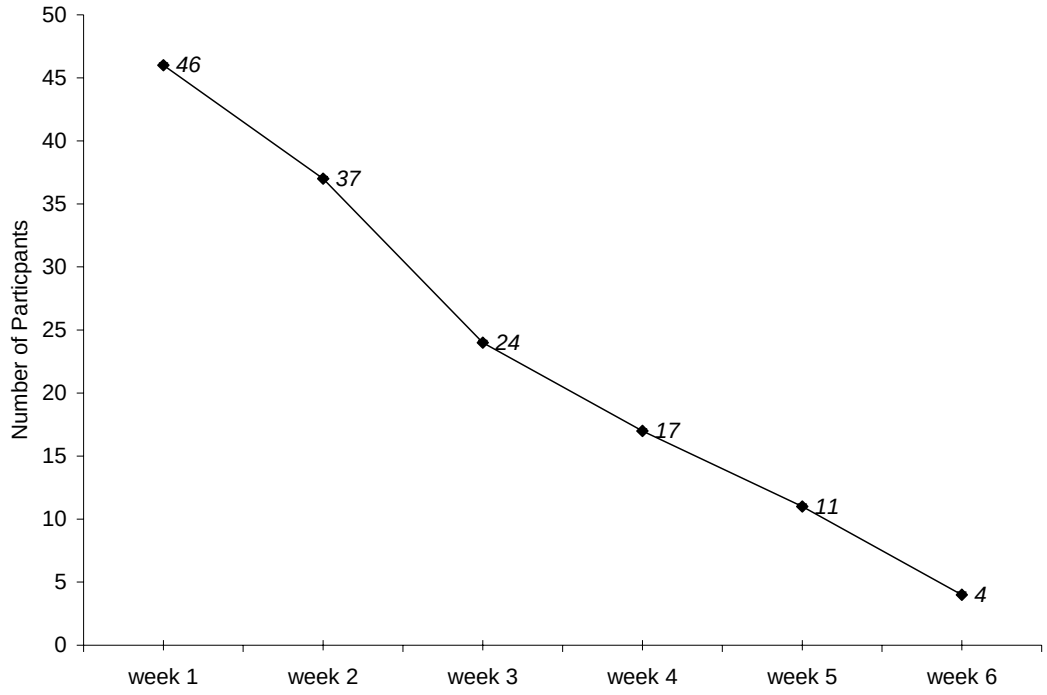

Figure 6. Program Attendance.

Note. N=53 at week 0.

Self-Selected Intensity and Adherence

Correlational analysis was utilized to investigate a potential relationship between initial intensity ratings and frequency of attendance. This correlation tested Hypothesis 6, which assumed participants adopting higher self-selected intensities (% 1-RM) would demonstrate poorer adherence to the prescribed program. No significant correlation was found between mean Week 1 intensity and frequency ($r = -.019$, $p > .10$).

CHAPTER FIVE

Discussion and Conclusions

Self-Selected Intensities

One of the most engaging findings from the present study is that the majority of participants initially self-selected an intensity at a level in agreement with commonly made recommendations, which would elicit strength and hypertrophy gains (≥ 60% 1-RM). Taking the mean 1-RM for all six exercises at session one yielded 60.12% ± 12.03%, which meets commonly suggested guidelines of ≥ 60% 1-RM to elicit strength and hypertrophy gains (Baechle & Earle, 2000, Glass & Stanton, 2004; National Academy of Sports Medicine [NASM], 2004). Therefore, the present findings are in disagreement with the known literature. Two previous studies by Glass and Stanton (1998, 2004) observed that self-selected intensities during resistance training fall short of common guidelines, and thus should not be suggested as an alternative to prescribed exercise programs, despite the noted possible effect for improving exercise adherence. The present investigation looked at self-selected intensities in a naturalistic exercise setting, as opposed laboratory experimentation as in Glass and Stanton's work. While self-selected intensities did in fact meet commonly suggested guidelines, they did not seem to affect adherence or program participation. The greater level of self-selected intensity observed in the present investigation could be due to the specific population of college age females (who were recruited primarily from exercise classes) and other variables that occur in naturalistic settings, such as self-presentational concerns or the

fear of looking incompetent (Leary, 1992). Also, because allowing the participants to self-select their own intensity that has been suggested to improve adherence (Cunningham et al., 1982; Dishman, 1994a; Glass & Stanton, 2004), concerns of self-presentation may be a valid variable to examine in the future. It seems, therefore, that further research is needed to investigate self-selected intensities with varied populations and the causes of potential differences.

One-Repetition Peak

In addition, because participants had not resistance trained in at least 2 years, perhaps never, obtaining a true 1-RM is questionable. During 1-RM testing, many participants may have reported a weight to be their maximum, not because they could not lift the weight, but rather they did not like the discomfort associated with the testing. Research has shown that efficacy during exercise elicits changes in effort (McAuley & Blissmer, 2000), and to the author's knowledge, no research has examined the effects of perceived exertion on maximum testing. Research has shown that individuals with a training history present significant differences between subsequent 1-RM testing sessions (Cronin & Henderson, 2004; Dias, Cyrino, Salvador, Caldeira, Nakamura, Papst, Bruana & Gurajao, 2005; Ploutz-Snyder & Giamis, 2001). Dias and colleagues (2005) found that 4 subsequent 1-RM sessions (48-72 hours apart) produced significant increases in muscular strength with trained individuals in bench press squat and arm curl exercises. The authors confirm that despite high test re-test coefficients between the first and fourth sessions (bench press, $r = 0.96$; squat, $r = 0.98$; arm curl, $r = 0.98$), statistically significant differences between loads lifted were found in all exercises when the two sessions were compared. Similarly, Cronin and Henderson (2004) showed that on double leg maximal

strength testing 7 to 10 days apart, test 2 (6.8%), test 3 (9.9%), and test 4 (15.0%) differed significantly ($p < .01$) from test 1. Similar results were found for single-leg 1-RM and upper body 1-RM. Participants were said to be novice, but were of an athletic background (hockey, rugby, and soccer) and had not weight trained 6 months prior to the study. Presently to the author's knowledge, there appears to be no research investigating the test-retest reliability of untrained, novice females. So, it is possible that the present study's participants' physiological capabilities were greater than those displayed during 1-RM testing, but the discomfort and/or poorer efficacy trumped completing the maximum repetition and participants assumed that was all they could lift. It is proposed to consider the participants initial 1-RM as a 1-repetition peak (1-RP), much like the difference between VO_{2max} and VO_{2peak} with aerobic exercise testing. If the initial 1-RM was rather a 1-RP and less than a true maximum, then participants' actual intensity as a percentage of maximum would be lower than stated in the present study, but would coincide with the findings of Glass and Stanton (1998, 2004).

Instructions and Weight Type

Another purpose of the present research was to determine whether the instructions given to participants or weight type would influence the intensity they would self-select during training. Specifically, this research sought to determine whether there existed variation among groups that were assigned to choose a load that they "should" versus the groups that were assigned to choose a load that was "comfortable." Overall, there was no difference between the two groups for either the percentage of 1-RM selected, the number of repetitions conducted, or RPE during their first exercise session. It seems that instruction type does not significantly change the amount of weight that an individual

will self-select under the present conditions. In other words, an individual told to choose a weight that they "should" use to increase muscular strength will not choose a significantly different amount compared to an individual asked to lift a weight at a level that is "comfortable." Also, there were no significant differences concerning intensity or repetitions when comparing the type of weights participants were using (machine or free-weight). It should be noted that differences due to instructions or weight type may actually exist, yet it is possible that environmental or self-presentational concerns (see Leary, 1992) caused participants to ignore instructions or lift more than they normally would. However, it appears that neither instructional differences nor weight type impact self-selected intensities to a large degree in the type of naturalistic setting used in the present study.

Concerning RPE, the mean across exercises for the first session was found to be 14.08 ± 4.05. Previous research suggests that ratings of perceived exertion at this level translates to between 80-90% of 1-RM (Gearhart et al., 2001; Lagally et al., 2004); however, exercisers in the present study were lifting only approximately 60% of 1-RM. The untrained, novice population utilized may account much of this discrepancy in the results. Thus, the present research suggests that there is a difference in perception of exertion during resistance training with untrained compared to trained individuals (Young, Lagally, McCaw, Medema & Thomas, 2002), and is a valid area of future research.

Changes in Self-Efficacy and Attendance

It was hypothesized that changes in SE ratings over time would be moderated by program attendance (Hypothesis 3). Based on Bandura's (1994) theorizing and previous

research documenting the powerful effects of mastery experiences on self-efficacy beliefs and resultant behavior (Wise & Trunnel, 2001), it was expected that, as beginning exercisers successfully engage and adhere in resistance training activities, their sense of self-efficacy should increase over time, perhaps resulting in adoption of more challenging intensities as well. Bandura's (2004) self–efficacy theory would predict such an occurrence due to accumulation of progressive task mastery. The regression model was significant, $F(3, 22) = 4.675$, $p < .05$, and the variance accounted for by the three predictor variables equaled 38.9% (Adj. $R^2 = .306$), but individual beta coefficients failed to demonstrate significant effects for any of the predictor variables, $t < .87$, $p > .10$. So, despite a significant, $t(25) = -3.311$, $p < .01$, mean increase in SE ratings from week 1 (57.74 ± 9.75) to Week 6 (63.90 ± 11.36), it does not appear that the changes in SE were moderated by program attendance. Thus, it does not appear that program attendance promotes participants to become more efficacious in resistance training.

Changes in Self-Selected Intensities and Self-Efficacy

Though the present study sought to examine whether or not self-selected intensities over time would be moderated by self-efficacy beliefs. In other words, as participants become more confident in their own abilities do they increase the amount of weight they are self-selecting? Despite a valid question, such analyses were not feasible due to the very high level of attrition over the six weeks of the present study. The attrition rate in the present study was quite pronounced, with over half the participants dropping out by Week 3 and 93% dropping out by Week 6 (Figure 6). As most individuals do seem to choose an intensity that would be commonly suggested if allowed to self-select their own weight in a naturalistic setting, it seems that perhaps we should

encourage individuals to choose weights at a level "lower" than they think they should, as is suggested by Glass & Chvala (2001) and Dishman (1994a). If the latter instructions do not lead to lower intensities and better adherence, attention may be more profitably steered toward behavioral modifications to enhance adherence.

Self-Efficacy and Adherence

Self-efficacy has been demonstrated as important in exercise choice, effort expended, and degree of persistence, in which continued persistence is synonymous with adherence (McAuley & Blissmer, 2000). In the present study there was a significant correlation ($r = .29$, $p < .05$) between the mean of the 6 weekly SE ratings and frequency of weight training, suggesting that participants with higher ratings of self-efficacy may demonstrate greater adherence to prescribed exercise programs. One should be cautious when interpreting these findings, however, as a great number of participants exhibited very poor attendance (over 50% of participants came to the gym less than 7 times during the course of the investigation). Also, though mastery experiences are a strong source of efficacy information (Bandura, 1997), it may be that participants' efficacy ratings were influenced primarily by the early trials of weight training. In this manner, all participants were able to experience a meaningful source of mastery experience even if they did not persist in the program.

Self-Selected Intensity and Adherence

Self-selection of intensity has recently been shown to be the preferred method of effort perception (Johnson & Phipps, 2006). Untrained individuals are exercising at gyms and other facilities using preferred exertion as they main method of intensity

selection. Seemingly advantageous, it has been suggested that allowing individuals to self-select their own exercise intensity will increase their adherence to exercise programs (Cunningham et al., 1982; Dishman, 1994a; Glass & Stanton, 2004). In the present study, however, there was not a significant relationship between the level of self-selected intensity and adherence. There was no significant correlation between week 1 intensity (% 1-RM) and frequency, and the intensity chosen by participants was in line with recommended guidelines. This suggests that, in the present setting, when given the opportunity to self-select intensity most participants will select an intensity near that which would be recommended; and regardless of the intensity they choose, there is no apparent relationship with attendance/adherence.

Concerns of Adherence

The present findings concerning poor adherence are an important contribution to the body of exercise and resistance training literature. It appears that even if individuals are allowed to self-select their own intensity to a prescribed resistance training program, the majority will not adhere to the program. Examining the results of follow-up questionnaires, participants revealed that a lack of time was the primary perceived barrier to exercise participation. This is in agreement with studies examining perceptions of barriers to exercise (Johnson, Corrigan, Dubbert, & Gramling, 1990). There is little research investigating if individuals actually do not have enough time to exercise. Heesch and Masse (2004) with 249 African American and Hispanic women ages 45 to 70, 28 hours per week were spent in sedentary, leisure-time activity. It would seem that individuals actually do have the time to exercise, but due to other factors, such as motivation, they perceive time as a barrier to consistent exercise. Also, much of the

current research with exercise and, specifically, resistance training seeks to develop methods to improve muscular adaptations and performance. As this research is valid and important contributions to the literature, it is vital to relay to the researchers and subsequent exercise professionals that despite optimal prescriptions to untrained individuals, the majority will not adhere to the prescriptions. Future research should seek to incorporate the physiological and applied sciences of resistance training with behavioral modification research in order to obtain optimal methods to improve adherence in new or returning exercisers.

Limitations

It should be noted, however, that the present study does have some important limitations. The sample size employed in the present study was relatively small, thus limiting statistical power to detect small or medium size effects. It may be that intensity of exercise does impact adherence, though only to a small degree. Also, because we did not want to coerce participants to exercise in any way, we did not provide any great incentive to exercise and it is unknown how committed subjects were to beginning and sustaining an exercise program compared to those who start one without prompting from an investigator. Also, the use of healthy participants who may prefer other types of exercise (e.g., aerobic training) may have led to results quite different than those that may be obtained using untrained or unhealthy (e.g., diabetes) individuals who might have different perceptions or motivations for weight training. Finally, the facility that participants exercised in brought about other self-presentational concerns that may not have arisen in other environments, thus potentially affecting the results of the study. The facility was structured in three tiers (cardio, machines and free weights). Many of the

participants expressed their fears of going down to the third tier (free weight section) to be noticed by all the men that congregated in that area. The area was even termed by some participants as "man-land". The second tier of machine weights held a similar, but not as seemingly aggressive threat to the participants.

Conclusion

Despite the limitations of the present research, preferred exertion during resistance training proves to be a valid area of future research, along with its suggested effects on adherence. While many exercise physiologists focus on methods to most effectively bring about physiological adaptation or positive health impact, one cannot forget that adherence to exercise is perhaps even more important. Even if one receives an optimal exercise program prescription, if he or she does not adhere to the program desired outcomes will not be obtained. Future research and efforts should begin to integrate exercise physiology and exercise psychology to optimize the effects of exercise for the individuals who need it most.

APPENDIX

Weight Training Self-Efficacy Measures

Weightlifting Perceptions

How certain are you that you can perform most of the lifts/exercises included in the prescribed program (chest press, shoulder press, back pulldown, biceps curl, triceps extension and leg press) at the levels described below?

Rate your degree of confidence by recording a number from 0 to 100 using the scale given below:

No Confidence					**Moderate Confidence**					**Complete Confidence**
0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%

Confidence (0-100)

1. I can perform these exercises with **5 pounds of resistance:** _____
2. I can perform these exercises with **10 pounds of resistance:** _____
3. I can perform these exercises with **15 pounds of resistance:** _____
4. I can perform these exercises with **20 pounds of resistance:** _____
5. I can perform these exercises with **25 pounds of resistance:** _____
6. I can perform these exercises with **30 pounds of resistance:** _____
7. I can perform these exercises with **35 pounds of resistance:** _____
8. I can perform these exercises with **40 pounds of resistance:** _____
9. I can perform these exercises with **50 pounds of resistance:** _____
10. I can perform these exercises with **75 pounds of resistance:** _____
11. I can perform these exercises with **100 pounds of resistance:** _____
12. I can perform these exercises with **125 pounds of resistance:** _____
13. I can perform these exercises with **150 pounds of resistance:** _____
14. I can perform these exercises with **175 pounds of resistance:** _____
15. I can perform these exercises with **200 pounds of resistance:** _____

RPE (Borg's 15-Category Scale)

6	*No Exertion at all*
7	*Extremely light*
8	
9	*Very Light*
10	
11	*Light*
12	
13	*Somewhat hard*
14	
15	*Hard (Heavy)*
16	
17	*Very Hard*
18	
19	*Extremely Hard*
20	*Maximum Exertion (Effort)*

ACSM 1-RM Protocol

1. The subject performs a light warm-up of 5 to 10 repetitions at 40 to 60% of perceived maximum.
2. Following a 1-minute rest with light stretching, the subject does 3 to 5 repetitions at 60% to 80% of perceived maximum.
3. The subject should be close to a perceived 1-RM in Step 2. A small amount of weight is added, and a 1-RM lift is attempted. If the lift is successful, a rest period of 3 to 5 minutes is provided. The goal is to find the 1-RM within 3 to 5 maximal efforts. The process continues until a failed attempt occurs.
4. The 1-RM is reported as the weight of the last successfully completed lift.

Testing Protocol (checklist)

1. Provide IRB, Health Questionnaire and Informed Consent
    a. Sign each
    b. Last 6 digits of SSN at top right corner of each
2. Collect IRB, Health Questionnaire and Informed Consent.
3. Provide summary sheet, and explain the study.
    a. Where study will take place (6 weeks @ 3 days/week)
    b. What machines/free-weights to use
    c. Where exercise logs will be located in SLC (pick-up/drop-off)
    d. How to use and fill out logs
    e. My contact information
4. Ask for any questions.
5. Provide Self-Efficacy Questionnaire to be filled out.
    a. Last 6 digits of SSN at top right corner of each
    b. Collect questionnaire.
6. ACSM 1-RM testing on pertinent equipment (6 exercises)
    a. Chest Press
    b. Pulldown
    c. Shoulder Press
    d. Leg Press
    e. Biceps Curl
    f. Triceps Extension
7. Ask for any questions
8. Give T-shirt

BAYLOR UNIVERSITY
Department of Health, Human Performance, and Recreation
Informed Consent Form

Title of Investigation: The effects of self-efficacy on preferred exertion during resistance training among healthy sedentary individuals

Principal Investigator: Rafer Lutz, PhD, Assistant Professor, Dept. of HHPR, Baylor University

Co-Investigators: Mark Faries
M.S. student, Dept. of HHPR, Baylor University

Rationale:
Despite ample evidence showing the benefits of regular resistance training for mental and physical health, much of the US population remains inactive. Many individuals repeatedly attempt to adopt resistance training regimens only to drop out a short time later. This research is designed to help us understand how intensity of weight training, experience with weight training, and personal beliefs may influence participation in exercise settings.

Description of the Study:
As a participant in this study, you will be asked to fill out a short packet of questionnaires and perform a brief set of weight lifting exercises on 6 different lifts (chest press, shoulder press, back pulldown, biceps curl, triceps extension and leg press) to maximal exertion. This first day of participation should take about 30-45 minutes. After this first day, you will be encouraged to do these 6 lifts on your own time for the next 6 weeks (~3 times a week) and asked to record the amount of weight you lift and number of repetitions you perform in a log kept in the SLC weight room. Each exercise session (performed on your own schedule) should take a total of about 15 minutes to complete. Also at the end of each week, you will be asked to fill out a short questionnaire concerning your beliefs about weight lifting, which will take about 2 minutes. This form will be e-mailed to you and you will be asked to return it by e-mail. At the end of 6 weeks, you will again perform the 6 lifts under supervised conditions to maximal exertion. In total, your participation should require about 1 hour per week or a total of 6 hours in addition to the initial and post assessments. It is, however, entirely your choice to either engage in weight training or refrain from weight training over the 6 week period.

Exclusionary Criteria:
All healthy females between the ages of 18 and 30 with no resistance training participation in at least the past 2 years are asked to participate in this study. However, you are not eligible to participate if you are pregnant, become pregnant, or have a desire for pregnancy, or have any health problems that would preclude you from participating in regular moderate, self-selected resistance training exercise. In particular, if you have any known heart condition, take medication for high blood pressure or a heart condition, or bone or joint problems that could be made worse by resistance exercise, or if you ever experience chest pains/dizziness, or if you know of any other reason why you should not engage in resistance training activity, you will not be eligible to participate.

You should understand that if you have any of the following conditions/symptoms, you are NOT eligible to participate in this research:

1. You have any known metabolic disorder including heart disease, arrhythmias, diabetes, thyroid disease, or hypogonadism.
2. You have a history of pulmonary disease, hypertension, liver or kidney disease, musculoskeletal disorders, neuromuscular or neurological diseases, autoimmune disease, cancer, peptic ulcers, or anemia
3. You are taking any heart, pulmonary, thyroid, anti-hyperlipidemic, hypoglycemic, anti-hypertensive, endocrinologic (e.g, thyroid, insulin, etc), psychotropic, neuromuscular/ neurological, or androgenic medications.
4. You have a known bleeding disorder.

Right to Withdraw/Confidentiality:
You may withdraw your participation now or *at any time during the study*. You should understand that your

participation is completely voluntary. Your decision to withdraw will not affect your care at this institution or cause a loss of any benefits to which you may be entitled. Also, we have no interest in knowing how a specific individual responds during the course of the experiment. Your name will not be associated with the data in any way. Code numbers will be used on all data to allow confidentiality, and a limited number of investigators will have access to your data. You should be aware, however, that e-mail is not secure and may be accessible to third party individuals. We will take all steps, however, to keep responses sent by e-mail confidential. Specifically, your name and e-mail address will be deleted after being replaced by your code number, and the e-mail file will then be permanently deleted from the primary investigator's computer. All data will be kept in a password protected computer in a locked office on the Baylor University campus. The results will be tabulated in the coming months, and will be available for you to review, should you wish to see the outcomes. It should be noted that identifying information (i.e., code numbers) will be eliminated from the data once the study is complete, and we will have no way to determine your individual scores at that time.

Risks and Benefits:
The present experiment presents some risk to participants, primarily as a result of engaging in strength training activities and performing a maximal lifts. There is also some risk concerning a loss of confidentiality of responses to study questionnaire measures and workout logs. However, all attempts will be made to minimize the occurrence of a breach of confidentiality and you are free to skip any questions that make you feel uncomfortable. You should know that responses you send by e-mail may not necessarily be secure.

While there are risks inherent to exercise participation (e.g., injury, fatigue, pain, etc.), because we are asking you to self-select the intensity and engagement, participation in the present investigation poses no risk beyond those posed by normal resistance exercise participation in which you would engage on your own time. There is perhaps additional risk during maximal testing, but all steps will be taken to minimize occurrence of injury. To protect your safety, you will be familiarized with and are to follow all SLC weight room safety guidelines during all testing and individual training sessions. During maximal exercise testing, you will be supervised by a certified personal trainer (National Academy of Sports Medicine) who is CPR certified and who is familiar with all emergency procedures in place at the SLC. All testing will occur during normal SLC hours of operation during which there is always a member of the weight room staff present. This staff member will be notified when testing is taking place and will respond to any emergency following SLC protocol.

You may not personally benefit by taking part in this study, though you may gain a better understanding of your exercise patterns and resistance training experience. You may also benefit by engaging in exercise more regularly, which has been shown to have numerous benefits to physical and psychological well being. The results of this investigation may allow a better understanding of the potential usefulness of resistance exercise prescription utilizing self-selection of intensities. Ultimately, such knowledge may help create better intervention programs for individuals who aspire to increase their physical activity participation. Considering inactivity and obesity rates and their effects on health in the United States, this is an important societal benefit.

Compensation for Illness or Injury:
Though your exercise participation in this research will occur as it does in your daily routines, it should be noted that if you are injured during the course of this investigation you should consult your personal physician to obtain treatment. The cost associated with any such care or treatment is your responsibility or the responsibility of your insurance carrier. You should be aware that Baylor University, the investigators' institutions, and the grant sponsor have not budgeted funds to compensate you for injury or illness that may occur during the course of this investigation and thus will not be accountable for such costs. However, I may be referred to my personal physician if there is any indication of injury, illness, or medical risk.

You should understand that if clinically significant symptoms occur during your participation in this research, or should you be injured during any of your testing or training sessions, you should report those to Rafer Lutz, Ph.D or Mark Faries. You may then be referred to discuss the problem with Melyn Galbreath, RN who is the research nurse for the ESNL at Baylor University. Upon her discretion, you may be referred to discuss the matter with your personal physician. Your personal physician will need to make any final determination as to whether you can continue your participation in the study. You should also understand, however, that you may be removed from participation at the researchers' discretion without intervention of your personal physician.

Costs and Payments:
You will receive a free T-shirt for participation in this study. This reward is not contingent on the amount of sessions you engage in and will be given out upon completion of the first day of the study. However, if you are an intercollegiate athlete you may not able eligible to receive any payment. Additionally, you will not be able to receive course credit as a result of participation in this research.

Statement of Conflict of Interest:
The researchers involved in collecting data for this study have no financial or personal interest in the outcome of results.

If you have questions at any time, please direct all inquiries to Rafer Lutz, PhD., Assistant Professor, Department of Health, Human Performance, and Recreation, Baylor University, P.O. Box 97313, Waco, TX, 76798-7313. Dr. Lutz can be reached at Rafer_Lutz@baylor.edu or 254-710-4024.

If you have any questions regarding your rights as a participant please contact the Baylor University Committee for Protection of Human Subjects in Research, Dr. Matt Stanford, Chair – Institutional Review Board, Department of Psychology and Neuroscience, One Bear Place, #97334, Waco, TX 76798-7334. Dr. Stanford may be reached at 254-710-2236.

I agree to indemnify and hold harmless Baylor University, its officers, directors, faculty, employees, and students for any and all claims for any injury, damage or loss I suffer as a result of my participation in this study regardless of the cause of my injury, damage or loss.

PARTICIPANT:
I have read and understand this form, am aware of my rights as a participant, and have agreed to give consent for participation in this research. I have been offered a copy of this informed consent form.

_____ _____ _____

NAME (Signature) date NAME (Please Print)

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