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THE PHYSIOLOGICAL EFFECTS OF SLACKLINING ON BALANCE AND CORE STRENGTH

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CORE STRENGTH

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ABSTRACT

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The purpose of this study was to examine the affect of slacklining on core strength and balance in college age students. Subjects consisted of students enrolled in two activity classes at a Midwest Division III university campus. Students enrolled in the circus arts class formed the experimental group, which consisted of a four-week slacklining treatment; and students in the indoor rock climbing class acted as the control group and did no slacklining during the training period. The researchers administered core strength and balance tests on both groups before and after the four-week training protocol using the Biering-Sorenson (BST), right and left lateral bridge (RLB and LLB), trunk flexor (TF) test and the Star Excursion Balance Test (SEBT). Upon examining the results of a MANOVA and a repeated measures ANOVA test, there are no significant differences between the experimental and control groups with regard to mean core strength at a 5% level of significance (p=0.140). However repeated measures ANOVA showed that there was a significant difference in the normalized mean balance scores between the experimental and control group at a 5% level of significance (p=0.004). With this information further research into the relationship between slacklining and balance should be investigated.

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INTRODUCTION

When walking through college campuses and city parks, an increasing number of people can be seen participating in an activity which has evolved from a simple climbing pastime to a fun, enjoyable activity with underlying health benefits (Rogers, 2008). The activity called: slacklining has been in existence for nearly thirty years and has moved far beyond its birthplace of the granite walls in Yosemite, to locations throughout the world (Rogers, 2008). Though slacklining has been around since the late nineteen seventies, there has been no research done on the physiological benefits of this activity.

Slacklining is an activity in which a participant tensions a length of one inch tubular webbing in-between two objects (trees, poles, etc.) at various heights above the ground. Once the webbing is tensioned, the participant attempts to walk from one end of the webbing to the other without touching the ground. Success in this skill requires many abilities such as balance and core endurance.

Many individuals view the act of standing and maintaining an upright balance as a simple uninvolved activity. In all actuality the feat of standing is a very complex system of on going maintenance of the relative positions of the body segments (Asseman, Caron, & Crémieux, 2004; Massion 1994). While the body is upright, many muscle groups are used to maintain the current position of the body and are ready to adjust to any outside factors which may disrupt the equilibrium in the body. While balance is not a skill that is automatic, there are many studies that show the benefits of training to improve balance. According to Mesure et. al. (1992), through training, the act of standing and balance becomes easier for the specific task. For example, gymnasts train so they are able to maintain a unilateral balance, without moving, in order to perform various balance maneuvers, such as the scale. When compared with non-gymnasts, gymnasts exhibit better unilateral balance (Asseman, Caron, & Crémieux, 2008). A study done by Perrin et. al. (2002) examined the balance control of judoists, ballet dancers, and sedentary participants. The results showed that the judoists exhibited the best balance control and the sedentary participants had the least control. The aforementioned studies demonstrate that people who engage in activities which require balance and postural control are able to outperform people who are untrained and lack a high level of balance. It is very likely that, through training, individuals have the ability to increase balance and postural control. An additional study performed by Vuillerme et. al. (2001) found that gymnasts were able to efficiently reinsert proprioceptive information to decrease center of foot pressure (COP) displacements. This information supports the thought that balance can be significantly improved through specific training.

The idea of using core strengthening exercises is relatively new to much of the general population. In the past this has been reserved for people in rehabilitation programs who experience low back pain (McGill, 2001). However, today core strengthening exercises have become increasingly popular and are being performed by people who are in good health (Williardson, 2007). Many studies have shown that core strengthening exercises have the likelihood to reduce lower back pain and lower extremity injuries (Williardson, 2007 & McGill, 2003). Several studies have researched unstable verses stable surfaces during exercise. Each of the studies involved two workout routines, which were exactly the same in nature, with the exception that one was performed on a stable bench and the other was done on a Swiss Ball. The results of this study showed that a Swiss Ball is a highly effective piece of equipment for core strengthening. The Swiss Ball requires the need to keep core muscles activated during the whole workout; as opposed to a work out on the stationary bench were focus is solely on the muscles completing the lift (Boyle, 2004 & Chek, 1999). Training which occurs on unstable surfaces may also lead to a decrease in other injuries, such as ACL injuries. Many studies have shown that exercises performed on equipment which is unstable may increase muscle spindle sensitivity, which yields an advanced readiness level where the athlete could respond quicker to a joint which is unstable and bring it back to a stable position (Williardson, 2007).

Since slacklining is a relatively new activity to the general population, and almost unused in the public schools. With the information public schools can start to integrate an activity, which is beneficial to their students, and the general population can also benefit from the activity's health enhancing qualities.

Therefore, the purpose of this study was to examine the effects slacklining has on core strength and balance.

METHODS

Subjects

All subjects in the study consisted of college aged males and females who were all enrolled in Exercise Sport Science activity (ESS 100) classes (N=23). The experimental group consisted of students enrolled in the Circus Arts class (n=12), also an ESS 100 class offered on campus, which teaches slacklining as part of the curriculum. Students from an indoor rock climbing class, another section of an ESS 100 class, (n=11) served as the control group for the study. All subjects from both groups had little to no prior slacklining experience. The subjects provided written informed consent (Appendix B) before any procedures took place and were informed that they may withdraw from the study at any time without a negative effect on their final grade in the class.

Research Design

The experimental group slacklined for fifty minutes, twice a week for a total of four weeks. The slacklines were set up in the same location during each training session at a height no higher then twelve inches from the ground when a participant is standing in the middle of the slackline (Appendix E). The safety protocols of the study followed those of the Circus Arts class (Appendix F).

The only restriction for the control group was to abstain from slacklining during the four-week testing period. Aside from that constraint the control group participated in activities, which were normal to the subjects daily life.

Testing Procedures

The study followed a pre and post-test format with a four-week period between the tests. All the subjects were trained in testing procedures prior to testing and were able to ask questions about how to perform any of the tests at any time during the assessment.

Balance Test

The balance test administered was the Star Excursion Balance Test (SEBT) (Gribble, 2003). The intertester reliability is .81-.93 and the intratester reliability is .82-.96 depending on the testing direction (Hertel, J. et. al., 2000). This test is used to examine the dynamic athletic balance of participants. Subjects were asked to measure their inseam from the medial side of their thigh to the end of their foot held in plantar flexion. This measurement was taken using a tailor's measuring tape and measured to the nearest centimeter. The subject taking the test stood barefoot, with the ball of their foot in the center of a star with eight points all set forty-five degrees apart from one another. The subject stood at the center of the star and maintained a one legged balance while maximally reaching out with the other leg in the eight directions, while maintaining the base of support (Gribble, 2003). Before the subject was assessed six practice trials were completed so that subjects could become familiar with the test as to decrease the possibility of a learning effect, which can potentially skew data. Once the six practice trials were completed, the subject completed the three-recorded trials. Subject alternated support legs after each trial to reduce fatigue and the subjects were also allowed to rest in between each trial as an additional measure to reduce possible fatigue. Researchers recorded each measurement, in centimeters, through a visual assessment of where the subject's toe touch occurred. The measurements gained from this test were converted into a mean score and then normalized with leg length for analysis.

Core Tests

The core tests, which were administered to the subjects, followed a similar pattern of practice prior to testing. For each core test the subject performed a ten second practice session to ensure that the test was being correctly performed. After the practice session the subject started the test when they felt rested. The tests were comprised of right and left lateral bridges, the Biering-Sorenson Test (BST) and the Trunk Flexor Test (TF) that are described in McGill (2007). The reliability for each test is as follows, BST; r=0.62-0.93 (J. Latimer et al., 1999), TF; r= 0.94-0.99, LLB; r=0.81-0.96, RLB; r=0.77-0.95 (Evans ,2007). In each of these core endurance tests the subject was tested until failure. For the left and right lateral bridges (LLB and RLB) the subject was positioned in a side bridge position, with one foot on top of the other. The subject supported themselves on one elbow and their feet while raising their hips off of the floor and creating a straight line with their body. The non-supporting arm was resting at their side or held across their chest holding the other shoulder (McGill, 2007). The Trunk Flexor Test required the participant to start in a sit up position with their hips and knees flexed at ninety degrees. The trunk was at a fifty-five degree angle to the floor (McGill, 2007). The Biering-Sorensen Test involves the subject lying on a table or bench face down, with their upper body suspended off of the table. Their lower body was secured and the subject held a position horizontal to the floor. The subject positioned their upper body with their arms crossed at their chest and their hands on their shoulders. For each of these tests the failure point was when the position was not maintained (McGill, 2007). For all tests the administrator would time the test with a digital stopwatch and round the results to the nearest second; while timing the test administrator also supervised the subject to make sure that the proper body position was being held. If the was a variance in the body posture of the subject they received one warning from the administrator to correct their posture. The test was ended when the subject was not able to hold the correct posture after one warning form the administrator.

Analysis

All statistical analyses were completed using the program Statistical Package for the Social Sciences (SPSS 16.0, Inc., Chicago IL.). Characteristics of subjects in the experimental and control groups were evaluated using standard descriptive statistics. Multivariate analysis of variance (MANOVA) was used to compare the changes in the four core strength measures between the experimental and control group. A repeated measures analysis of variance (ANOVA) was used to compare the balance scores of the two groups as well as if there were differences between the right and left leg. The level of statistical significance was set at 0.05 for each procedure.

RESULTS

The results of the study are based upon twenty-three subjects, twelve in the experimental group and eleven in the control group. Even though there was a significant difference in the pre-test balance scores (P=0.015) and lateral bridge scores(rt. P=0.001, lt. P=0.005) the implications of this may not be serious due to the nature of the tests. Since there is no functional upper limit of the amount of time a subject can hold a certain pose the statistical difference of lateral bridge scores between groups should not be considered a drawback. The difference in the balance scores could be more serious because there could be more of an upper limit in the SEBT since a subject can only anatomically reach a certain distance away from the midline of their body. These differences should be taken into account when reviewing the results.

The changes of core strength were analyzed using a MANOVA inference procedure. The results from this test showed that the changes in the four core strength measures between the two groups were not significantly different (P=0.140). The P-values for the four core tests are as follows; BST: P = 0.568, LLB: P = 0.421, RLB: P = 0.744, and TE: P =0.206. The results are presented in Table 1. The mean and standard deviation of the core strength tests are presented in Table 2.

Table 1. Results from MANOVA core strength battery.

Test	P-value
Biering-Sorenson Test (BST)	0.568
Left Lateral Bridge (LLB)	0.421
Right Lateral Bridge (RLB)	0.744
Trunk Extension (TE)	0.206

*Significant difference ($p<0.05$)

Table 2. Core strength results from pre and post testing (mean ± SD).

Group and Test	Pre-test	Post test	Change
Experimental			
BST	108.7 ±30.4	106.2 ±32.1	-2.5 ±34.9
Left Lateral Bridge	44.4 ±17.5	47.9 ±21.3	3.5 ±17.3
Right Lateral Bridge	41.8 ±15.3	51.8 ±17.3	10.1 ±18.2
Trunk Extension	110.9 ±57.3	123.5 ±53.8	12.6 ±71.1
Control			
BST	132.0±50.3	140.2 ±54.5	8.2 ±52.4
Left Lateral Bridge	76.3 ±18.1	73.4 ±34.1	-2.9 ±20.2
Right Lateral Bridge	66.0 ±19.1	73.6 ±24.1	7.6 ±18.7
Trunk Extension	122 .2 ±51.4	99.7 ±37.4	-22.5 ±56.0

*Significant difference (p<0.05)

The balance scores were analyzed using an ANOVA with repeated measures. The results showed that there was a significant difference between the experimental and control groups after the four-week training protocol (P=0.004) at the 5% level of significance. Since there was no significant difference between legs (P=0.869), the scores are averaged over both right and left legs. This is illustrated in Table 3. The mean and standard deviation of the balance test is presented in Table 4.

Table 3. Results of ANOVA with repeated measures on the SEBT.

Change in balance scores over time	P-value
Control vs. Experimental	0.004*
Right foot vs. Left foot	0.869

*Significant difference (p<0.05)

Table 4. Balance test results from pre and post-testing (normalized average data).

Group	Pre-test	Post-test
Experimental	0.76±0.06	0.82±0.08
Control	0.83±0.07	0.84±0.07

*Significant difference (p<0.05)

DISCUSSION

The overall results of these tests showed that there was no significant difference in the four mean core strength measures between the two groups, but there was a significant difference in mean balance scores between the control and experimental group. From charts in Appendix E, where there is a significant difference, the bar chart displays this very clearly. Data of the control group exhibits a small difference from zero where the experimental group presents a larger difference from the zero mark.

There are various reasons that could have influenced these outcomes. Behm et. al. (2005), Boyle (2004), Chek (1999) and Stanton et. al. (2004) all examined the effects of Swiss balls on various types of training. The commonality between all of the studies was the testing being looked at as a stable versus unstable training platform. In all of the studies, subjects who trained on the unstable platform showed greater improvements in core strength then their stable platform counterparts. From the results of the studies above, readers may foresee slacklining improving core strength due to the physiological need for control over the whole body in order to successfully walk from one end of the slackline to the other. However that is not the case in this study; two possible limitations that could have nullified the effects of training on an unstable platform could be the teaching progression and sample populations. If subjects did not have a spotter on each side of the slackline while they were learning to walk the subject would have to use more of their core muscles to stabilize them while attempting to walk on the line. Having spotters would allow students to use their upper body in conjunction with the spotters to stay up right while walking on a slackline, which could have accounted for the lack of significant difference in core strength.

The groups used during the study were college age students that had self-selected into either the control group or experimental group. Even though the control group did not slackline they were actively participating in a climbing class and could have improved their core strength while partaking in that activity.

From the data gathered it was found that there was a significant difference in the initial testing between the control and experimental groups in balance as well as the lateral bridge test. The reasoning for this difference is unexplainable.

Asseman et. al.(2008), Mensure et. al. (1992), and Perrin et. al. (2002) found that balance can become easier for a specific task through training. Asseman et. al. (2001) and Mensure et. al. (1992) examined the balance of elite gymnasts verses non gymnasts and found that gymnasts performed better then non-gymnasts when skill was similar to their gymnastic training. Perrin et. al. came to a more broad conclusion when looking at judoists, ballet dancers and sedentary people, which was that people who are engaged in activities which require balance can increase their balance. The results of this study show similar findings to those listed above. The experimental group, which was involved in a balance specific task, improved their balance level significantly in comparison to the control group. Some rationales to explain the increase in balance can be attributed to the idea that the experimental group was performing a task, which had more carry over into the SEBT then the control group, and thus showing an increase in balance. Another reason for the increase could also be simply the experimental group was able to train their bodies to control movements on a non-stable medium and thus are better apt to demonstrate improved balance on a stable medium.

The physical education field can also benefit from the new knowledge about slacklining. Again having a novel skill for students could elicit activity in students who would otherwise pass on a physical activity. As non-traditional activities become more popular in schools, students as well as staff members are always looking for something new to learn and teach. Slacklining can fulfill almost all of the NASPE requirements, which makes adding the activity easier for staff who are trying to follow state and national standards. Through slacklining students will demonstrate knowledge in motor skills and movement patterns so they are able to execute a wide range of skills through the increased balance they acquire through slacklining. Students can learn about strategies and concepts of slacklining such as how to set-up the activity and how to efficiently walk from one side of the line to the other. This activity can provide students with another option to participate in which in turn can increase their physical activity level. This activity can also provide students with the opportunity to improve their social behaviors through discussing various ways to perform movements while slacklining as well as working together to set-up and take down the slackline. Finally, subjects who slackline can turn this pastime into an activity which can challenge them and provide them with enjoyment for a lifetime.

In closing, it is important to be aware that there has been no previous research done on the physiological effects of slacklining. The results from this study are from a relatively small sample size and small time frame. Because of these factors it could be beneficial for more in-depth research to occur on the subject. Even though there is a small amount of research done, people can use the knowledge provided in this study to improve and expand physical education curriculum, which can enrich the lives of students through physical activity.

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APPENDIX A

REVIEW OF RELATED LITERATURE

REVIEW OF LITERATURE

The general physical education curriculum through out the United States has been shifting from traditional team and individual sports such as basketball, football and tennis to allow for more non-traditional and life long fitness activities like pilates, adventure education and outdoors pursuits. This trend seems to be spreading through the general public as well. For example, when walking through college campuses and city parks, more and more people can be seen participating in an activity, which has evolved from a simple climbing pastime to a fun, and enjoyable activity. Slacklining may also possess underlying health benefits (Rogers, 2008).

The popularity of slacklining is spreading across the nation. As it spreads an idea surfaces that slacklining could be taught to many students and young people who could use this fun and enjoyable hobby and turn it into a lifetime activity. In order for slacklining to be accepted in the school system the benefits of the activity must be assessed and benefits quantified. Though slacklining has been in existence for nearly thirty years there has been no research done on the physiological benefits of this activity (Rogers, 2008).

With the aim of providing a comprehensive view of slacklining, it is important to examine additional aspects linked with slacklining. Readers will be able review the subtopics which are related to the study in order to gain an awareness for expanding the research on the physiological benefits of slacklining. The subtopics of this review consist of slacklining, balance, core strength, motor learning and alternative activities in physical education.

SLACKLINING

Slacklining has been around for nearly thirty years and has traveled far beyond its birthplace of the granite walls in Yosemite National Park, to places throughout the world (Rogers, 2008). When climbers in Yosemite were not climbing, they were looking for other activities to become involved in to pass the time. The idea of slacklining came about when climbers tried to walk on chains, barricades and other objects around the park. The climbers eventually started using climbing rope between trees to hone their skills and it has since evolved into the use of tubular webbing. This same item is the material used today (Rogers, 2008).

Slacklining is an activity in which a participant tensions a length of one inch tubular webbing in-between two objects (trees, poles, etc.) at various heights above the ground. Once the webbing is tensioned the participant attempts to walk from one end of the webbing to the other without touching the ground or using other objects for assistance. This skill requires many abilities such as balance and core endurance make the attempt a success.

BALANCE

The vast majority of people view standing as a simple and uncomplicated action. In all actuality the feat of standing is a very complex system of on going maintenance of the relative positions of the body segments (Asseman F, Caron O & Crémieux J, 2004 and J. Massion, 1994). The body relies on many different sensory inputs to relax and contract numerous muscles in order to keep the body up right and standing.

Mesure et. al. (1992) found that, through training, the act of standing and balance becomes easier for the specific task. For example, gymnasts train so they are able to maintain a unilateral balance, without moving, in order to perform various balance maneuvers, such as the scale.

Asseman et. al. (2008) also researched the difference that training has on postural control and balance. For this study the researchers took elite gymnasts, and compared them against other athletes who had not had any gymnastics training. The protocols for the study consisted of having each participant stand on a force plate in a bipedal and unipedal formation. Both formations consisted of the participants having their eyes closed and their eyes open. The results that Asseman and his colleagues found was that the gymnasts performed as well as the non-gymnasts when the participants had to maintain the untrained posture of the bipedal formation with their eyes open and closed. The same was true for the unipedal formation with the eyes closed. The results of the unipedal eyes open test did show that the trained gymnasts exhibited a better postural control then the non-gymnasts. The suspected reason behind this results is that gymnasts train with their eyes open and the position tested is one which gymnasts use during training. This study demonstrates that improvement of postural control and balance can be made through specific training for balance.

A Study done by Perrin et. al. (2002) examined the balance control in judoists, ballet dancers, and sedentary participants. The results showed that the judoists exhibited the best balance control and the sedentary participants had the least control. The above studies show that people who are engaged in activities which require balance and postural control are able to out perform people who are untrained. Perrin and cohorts believe that through training individuals have the ability to increase balance and postural control.

A study performed by Vuillerme et. al. (20010 suggested that gymnasts were able to more efficiently reinsert proprioceptive information to decrease center of foot pressure (COP) displacements then non gymnasts. During this study, Vuillerme studied balance in expert level male gymnasts who had been competing for at least ten years at the regional level or higher. The control group was comprised of male non-gymnasts who were experts in soccer, tennis or handball. For the experiment each participant stood barefooted on a force plate, from this their COP was measured. The participants then had four mechanical vibrators attached near the tendons of their gastrocnemius and tibialis anterior muscles, with rubber bands. These vibrators where used to cause a proprioceptive disturbance. The results, as stated before were that the gymnasts were able to reinsert proprioceptive information quicker then the non-gymnasts. This is evidence that when balance is disrupted, a trained gymnast, or presumably a person who has had balance training, would be able to regain their balance quicker than a person who is untrained.

Another study done by Vuillerme et. al. (2001) researched whether expert gymnasts were able to carry over dynamic sport specific balance skills to non-athletic balances and balances in daily life. Six gymnasts and six non-gymnasts who were expert athletes were put through non-athletic balances to see if there was more skill transfer from gymnasts to general balance. The balance tests performed consisted of six progressively harder tasks; bipedal, unipedal, and unipedal with unstable support (i.e. 7 cm thick foam surface). These were done with and without vision. The test results showed that as the tests increased in difficulty, the balance exhibited by the participant decreased; but it was a decrease among all participants. From the results it was concluded that even though the maneuvers performed by gymnasts require a tremendous amount of balance there is little to no carry over to other general balance activities. However, when vision was removed the gymnasts were able to maintain postural control better then the non-gymnasts. The conclusion Vuillerme et. al. proposed was that gymnasts have better remaining sensory modalities and are able to compensate for the lack of vision during postural instability.

From many of the studies reviewed above a common theme suggests that if a participant is involved in balance related activities they can increase their overall balance and postural control.

CORE STRENGTH

The concept of using core strengthening exercises is relatively new to much of the general public. In the past, this has been reserved for people in rehabilitation programs who suffer from low back pain (McGill, 2001). However, today core strengthening exercises have become more popular and are being performed by people who are in good health (Williardson, 2007). Many studies have shown that core strengthening exercises have the likelihood to reduce lower back pain and lower extremity injuries (Williardson, 2007 & McGill et. al. 2003). Several studies have looked at unstable verses stable surfaces during exercise. The studies involved two workouts which were exactly the same, except that one was performed on a stable bench and the other was on a Swiss ball. This study showed that Swiss balls are a highly effective piece of equipment for core strengthening due to the need to keep core muscles activated during the whole workout;

as opposed to a stationary bench where focus is solely on the muscles completing the lift (Boyle 2004 & Chek, 1999).

Training which occurs on unstable surfaces may also lead to a decrease in other injuries, such as ACL injuries. Studies have shown that exercises performed on equipment which is unstable may increase muscle spindle sensitivity, which yields an advanced readiness level where the athlete could respond quicker to a joint which is unstable and bring it back to a stable position (Williardson, 2007).

A study done by Stanton et.al. (2004) looked at the effect of short-term Swiss ball training on core stability and running economy. The study involved eighteen young males who were split into a control and experimental groups. The experimental group performed two Swiss ball sessions for six weeks. Each participant was put through numerous tests including, VO_{2max} Test, core stability, electromyographic activity of the abdominals and back muscles. The results from the study showed a sizable difference in the pre and post testing in the experimental group and little change in the control group. Stanton et. al. (2004) suggests that Swiss ball training does significantly improve core stability and improves time to failure in a Swiss ball prone stabilization core stability test. Surprisingly the electromyography results of the core muscles were not altered from pre to post testing. From this study we can see that it is possible to increase core strength and stability solely by participating in activities, which force people to keep their core muscles activated.

Behm et. al. (2005) has looked at the effects of unilateral and unstable exercises. The study looked at muscle contractions while performing weight lifting exercises on an unstable platform, a Swiss ball. The study took a look at bilateral and unilateral dumbbell bench and shoulder presses as well as six trunk exercises. The results that Behm and others found are fairly consistent with other studies on exercises involving an unstable platform. The trunk exercises elicited a greater activation while being performed on the Swiss ball. This was also the case for the unilateral dumbbell bench press. Behm and cohorts found that exercises done on unstable equipment (i.e. a Swiss ball) will elicit greater core activation and improve core strength. The same holds true for unilateral exercises done on unstable pieces of equipment.

This study, like many others, reinforces the importance of using unstable equipment to trigger a greater abdominal contraction. This idea can also carry over into slacklining. The activity requires walking on an unstable piece of webbing, without core strength the successful completion of this task would be very difficult. By using a slackline the believe is that core strength will improve because trunk muscles will need to be used to stabilize the body in order for the participant to successfully walk across the slackline.

MOTOR LEARNING

Researchers Savion-Lemieux and Penhune (2005) studied the effects of practice and delay on motor skill learning and retention. For this study, the researchers took participants and had them learn ten-element visual sequences and be able to reproduce them through tapping at the same time as the visual stimuli. The participants were randomly selected to either a varied practice or varied delay condition. The conditions were either one, three or six practice sessions before a standard four week delayed recall for the varied practice groups or three practice sessions followed by either a delay session of three days, or two, four or eight weeks. To assess the participants, the researchers looked at changes in accuracy, variance in response and percent response asynchrony. The findings from this study show that learning and retention of the task was not affected by the amount of practice, but the amount of practice sessions in a period of time. This is a very important result due to the length of the experimental trail in the slacklining study. The participants in the slacklining study had eight practice sessions spread out over four weeks. Even though the students had a shorter time to learn a motor skill, they were able to have multiple practice sessions to learn the motor skill, which from the results of this study show that multiple sessions are more important for learning the amount of practice time.

In a study done by Crespo and Reinkensmeyer (2008), it was found that haptic guidance, a technique where a machine or human physically assists the learner during movement practice, can improve the instant performance of a motor task. The study looked at using a mechanized program to assist beginner drivers execute proper turns. The program helped the learners as needed, by using more force to move the steering wheel when there was a higher degree of error. This was looked at versus fixed guidance and no guidance. The results of the study found that the guidance as needed group was able to learn how and when to initiate turns with less error then both of the groups initially. As the study continued the margin of difference between the groups was reduced. The idea of using haptic guidance, such as an additional person walking next to the learner providing a balance point as needed while learning to slackline can be beneficial to the learner by improving their success rate which can increase their desire to continue practicing and allow for a faster initial adaptation to the task.

Shea, Wulf and Whitacre (1998) analyzed the effects of physical guidance on learning to perform slalom type ski movements on a ski simulator. The researchers observed participants on a ski simulator with and with out the use of ski poles. The procedures followed where that for the first two days of practice one group would use ski poles and the other would not. At the end of the second day both of the groups performed a test to see if the motor skill was retained. The results from that assessment were that the group utilizing the poles were more efficient movers then the group without poles. The third day of testing was the retention test and the results of this were that to pole group had a more efficient movement then the non-pole group. The second part of the experiment consisted of looking at how the poles functioned to enhance the learning. The results showed that the poles had beneficial effects on the learners, not only during the practice time, but also on the motor skill. This study echoes the study done by Crespo and Reinkensmeyer which suggests that haptic guidance or physical guidance can improve motor learning.

A study done by Hauptmann and Karni (2002) also were interested in the amount of learning time needed to increase performance in a motor skill. For their study a letter enumeration task was used and subjects attempted to decide as fast as possible if the string of letters was odd numbered or even numbered. The subjects were also split into groups where amount of training, subsequent experience with a different list, and inter-session interval length were varied. The results showed that the subjects with lesser amounts of training performed just as well as the subjects who had a longer training time. This shows that minimal practice time is adequate to produce performance gains.

In the book, Motor Learning and Performance, Schmidt and Wrisberg go through various tactics to assess motor learning. One method that is covered in the text is to simply observe the learner in effort to gauge proficiency level. This method is one which is pertinent to the slacklining study. Even though the class does not grade nor assess a student's slacklining skill, informal assessment can still be made on participants in the class. From what the researchers were able to observe and through discussions with the other instructors of the class, many of the students progressed through the beginning stages of the activity and have became mid-level slackliners. Through observations in the class, it can be said that the participants in the slacklining study have learned the motor skill of slacklining.

The Authors Kelly and Melograno have also weighed in on motor learning. In their book, Developing the Physical Education Curriculum, they offer some suggestions about various motor learning times during life. The first for example is the idea that there is very little published data about how long it takes instructors to teach a motor skill and how long it takes students to learn a motor skill. The authors claim that there are two reasons behind this. The first is that physical education is a unique environment with many factors that influence learning. The second is that very few things in a physical education class are evaluated to a mastery level. Skill mastery can be influenced by many different factors such as teacher competency, class size, equipment availability and even student age. This is yet another reason that many motor learning times have not been published. With such a wide range of variables it is almost impossible to establish a specific time that skill mastery can occur. The last large topic that Kelly and Melograno bring up is that the older the learner, the average amount of time needed to teach and learn a skill should decrease because the learner's cognitive abilities will increase. This increase may possibly lead to more efficient learning.

In conclusion, many activities do not have published mastery times for reasons, which have been listed above; although one way to find if the students have learned or are in the later stages of learning a motor skill is through simple observation. The time it takes to learn a motor skill is not necessarily dependent on the amount of time put into practice, but the way that the practice schedule as been organized. Participants with a practice schedule that has multiple practices spread out over a longer period of time can actually learn the motor skill more efficiently then if there were fewer practice bouts with more time for each bout. The concept of utilizing haptic guidance to quicken motor learning is also used in the slacklining study. Having another student along side the participant as a stabilizer can decrease the time to learn a motor skill.

ALTERNATIVE ACTIVITIES IN PHYSICAL EDUCATION

In today's physical education classes there are activities explored that stretch beyond traditional, individual and team sports. While different than traditional activities, alternative activities are still teaching students neseccary skills and behaviors but are using activities which focus on life long skills and give students more choices in activities to pursue in their own time.

Juggling is an example of a nontraditional activity which can be done for a lifetime. A study done be Catanzariti (1998) explored at different teaching techniques for learning the three-ball cascade. For Cantanzariti's study a group of students from an introductory physical education course was split into two groups; one group would juggle two feet away from a blank wall and the other would juggle twelve feet away from a blank wall. Both of the groups took part in two fifteen-minute lessons on three ball juggling. The groups were assessed three times; one pre and post-test and then a retention test where the participants were not allowed to juggle for a week prior to testing. The results from this study showed that practicing near a wall did not affect the performance or skill acquisition of three ball juggling.

The researchers from this study were interested if a ropes course experience would change how at-risk students viewed their classmates and if they would give their class a higher CES (Classroom Environment Scale) rating in involvement and affiliation. The study was set up in a pre-post format with a group of students who were identified as at risk for internalizing behaviors and a group of students who were identified as at risk for externalizing behaviors. The students were grouped this way through the Systematic Screening for Behavior Disorders (SSBD) and the disorders were then validated by the teachers. The comparison between the pre and post CES test showed that the groups that internalized behaviors improved in involvement and that all of the groups significantly improved in involvement. Only one of the middle school groups decrease in affiliation. Another portion of the CES was an open-ended survey that asked the students about their feelings of trust towards their classmates and if they could transfer their ropes course experience back into the classroom. The results from both questions were split with a portion of the class making comments about the ability to work together while the other portion wrote comments about things like making fun of others and not working together. Overall the researchers found that there was not a significant increase in the CES dimensions tested.

Ward and Yoshino (2007) wanted to take a more in-depth look at the outcomes of a short-term adventure education skills course and what the students thought of their experiences during the course. The courses were various adventure education skill classes taught at a Midwestern university where the format of the class was one to two classroom periods and then a weekend clinical portion. For all of the courses a personal reflection paper was assigned as part of the student's grade in the class. In this paper the students reflected on what they learned about them selves and how they could relate the knowledge gained in the class to their own personal life. The papers where then analyzed for common categories and themes; the researchers found that there were about sixteen categories that were present in the reflections these categories ranged from self-improvement and accomplishment to environmental stewardship. The categories were then grouped into three common themes consisting of interpersonal, intrapersonal, and situational/environmental relationships; among these the most prevalent was intrapersonal. From the data gathered the researchers found that this study supported previous works and that short-term adventure courses offered similar effects of long-term courses.

Hatch and McCarthy (2005) have investigated long-term effects of challenge courses on student organization members. The goal of the study was to see if a challenge course could provide any lasting and long-term effects on group members in the areas of group cohesion, and effectiveness and individual effectiveness within the group. The group was assessed at four different times; the first time acted as the baseline and occurred one week before the test, a pretest occurred immediately before the course, a post test took place immediately after the course and lastly a follow-up assessment was done two months after the culmination of the course. The results showed that group function did not change from baseline pretest. From pretest to posttest there was a large increase in-group functioning but when analyzing the follow up scores researchers found that they had dropped back to the level of the pretest and baseline scores. In the article the researchers offer some suggestions as to why last gains were not seen. One source make a reference to the participants not having enough training in order to take the skills that have been learned and generalize them into their everyday lives. Another suggestion is to have follow meetings or classes with the participants in order to focus on the transfer of what was learned at the course into the everyday lives of the participant. From studies referenced by Hatch and McCarthy it has been shown that with strategies listed above gains in teamwork have been seen at a six-month follow up period. The study and the others mentioned within show that there is not only a short-term benefit to challenge courses but a potential long term benefit can be present as well.

From the studies above it is clear to see that learning in the physical education classroom can come from many alternative activities, some of which many be life long activities for some students who are exposed to the wide range of alternative endeavors that can be taught in a physical education class.

SUMMARY

The materials which have been reviewed above provide some ideas about motor learning, alternative activities in physical education and how balance and core strength are affected by outside sources like physical activities. Many studies which have been reviewed above have shown that balance can improve if a subject is participating in activities which have balance components in them. Studies have also concluded that subjects can increase core strength by participating in activities where trunk muscles must be continually activated. Even though research has been done in the fields previously discussed there has been little to no research completed on slacklining and the physiological effects associated with the activity.

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APPENDIX B
INFORMED CONSENT

Protocol Title:	The Physiological Effects of Slacklining on Balance and Core Strength
Principle Investigator:	Benjamin Mahaffey 1620 16th St South La Crosse, WI 54601 (608)712-5886
Emergency Contact:	Benjamin Mahaffey (608)712-5886

- **Purpose and Procedure**
  - The purpose of this study is to determine the physiological effects of slacklining on balance and core strength.
  - My participation will involve slacklining fifty five minutes, two times per week for eight weeks (experimental group).
  - The total time requirement is ten hours in an eight week-period.
  - The testing will take place on campus in an area where a slackline can be set up.
  - The testing will be in a pre and post test format.
  - During all tests there will be at least one spotter to help me balance or to spot me if I fall off of the slackline.

- **Potential Risks**
  - I may experience muscle soreness in my legs, core and/or arms.
  - The risk of serious or life-threatening complications, for healthy individuals, like myself, is near zero.

- **Rights and Confidentiality**
  - I can withdraw from the study at any time for any reason without penalty.
  - The results of the study may be published in scientific literature or presented at professional meetings using grouped data only.
  - All information will be kept confidential through the use of number codes. My data will not be linked with personally identifiable information.

- **Possible Benefits**
  - I and others involved in the study may benefit by understanding how slacklining impacts balance and core strength.

Questions regarding study procedures may be directed to Benjamin Mahaffey (608-712-5886), the principal investigator, or the study advisor Dr. Jeff Steffen, Department of Exercise and Sport Science, UW-L (608-785-6535). Questions regarding the protection of human subjects may be addressed to the UW-La Crosse Institutional Review Board for the Protection of Human Subjects, (608-785-8124 or irb@uwlax.edu).

APPENDIX C
DATA SHEET

PRE TEST Name_______________ Age______ Leg Length________
SEBT
Standing on **LEFT** leg

Trial	Front	U.Right	Right	L. Right	Back	L. Left	Left	U. Left
1								
2								
3								

Standing on **RIGHT** leg

Trial	Front	U.Right	Right	L. Right	Back	L. Left	Left	U. Left
1								
2								
3								

Core assessment
BST __________
L. Bridge __________
R. Bridge __________
Trunk __________

POST TEST Name_______________ Age______ Leg Length_______
SEBT
Standing on **LEFT** leg

Trial	Front	U.Right	Right	L. Right	Back	L. Left	Left	U. Left
1								
2								
3								

Standing on **RIGHT** leg

Trial	Front	U.Right	Right	L. Right	Back	L. Left	Left	U. Left
1								
2								
3								

Core assessment
BST __________
L. Bridge __________
R. Bridge __________
Trunk __________

APPENDIX D
UNIVERSITY IRB PROPOSAL

The Physiological Effects of Slacklining on Balance and Core Strength

1. The purpose of this study is to examine the physiological effects of slacklining* on balance and core endurance. The study will start at the Fall semester 2008 and culminate six weeks after the start date. The study will have two randomly assigned groups, one control and one experimental. The experimental group will be the ESS 100 Circus Arts class, in which slacklining is a normal part of the curriculum. During the class they will be slacklining fifty five minutes two times per week for a six week period. The control group will consist of another ESS 100 activity class. Balance and core endurance tests will be given as pre and post tests. The tests will be comprised of right and left lateral bridges, the Biering-Sorenson test and the Trunk flexor test (McGill, 2007) for core endurance and the balance test which will be administered is the Star Excursion Balance Test (SEBT) (Gribble, 2003). Both the control and experimental group will participate in all tests.

2. The subjects will be comprised of approximately forty to fifty college aged (18-25) males and females enrolled in ESS 100 activity classes who have had little to no slacklining experience. The reason for using subjects from this demographic is the ability of access to the participants.

3. Not applicable

4. For this study voluntary consent will be obtained before any of the testing procedures start. The consent form will be signed either at the testing area, outside by the slackline or after asking for participation in an ESS 100 class. A copy of the informed consent form has been attached.

5. All information gathered from this study will be in a three ring binder kept in a locked filling cabinet in Dr. Jeff Steffen's office. All subjects will be coded and no names will be used during or after the study.

6. During this study participants could experience muscle soreness in their legs, arms and/or core. This soreness will be from muscle use and should be considered normal. Injuries that could occur from this study are low but could be sprains/strains of joints from losing their balance while on the slackline. The time frame that the participants are needed is for fifty five minutes, two times a week for six weeks. The total time expended in the study will be ten hours. The pre and post tests will have no effect on the students and will require a total of twenty minutes of the student's time.

7. Protocols used in this study will follow normal ESS 100 Circus Arts spotting and safety protocols, which include the following; verbal explanation of how to safely walk on the slackline and how to properly dismount. In addition to the verbal instructions there will be two spotters walking next to the participant while they are walking on the slackline. The spotters will be there to physically support and help the participant balance on the line early in the study. Once the participant feels confident to balance or walk on the slackline without assistance the spotter will be next to the participant to help control a fall if needed. The safety protocols should be highly effective and provide participants with a safe experimental environment. Standardized administrative testing protocols will be followed for tests.

8. The anticipated benefits to participants and the general public will be feedback on the knowledge of how a slackline effects balance and core endurance.

* Slacklining is an activity in which a participant tensions a length of one inch tubular webbing in-between two objects (trees, poles, etc.) at various heights, not to exceed twelve inches above the ground. Once the webbing is tensioned the participant attempts to balance and walk from one end of the webbing to the other without touching the ground.

APPENDIX E
DESCRIPTIVE DATA

CORE STRENGTH DATA:

(All numbers have been rounded to the nearest second)

Control Group:

	PRE TEST				POST TEST			
Subject #	BST	LLB	RLL	TF	BST	LLB	RLB	TF
1	120	85	65	110	205	70	45	120
2	70	55	16	147	168	14	40	60
3	129	103	68	77	104	103	76	89
4	123	63	62	117	97	62	65	140
5	212	56	58	121	203	32	48	108
6	200	96	93	68	170	111	101	139
7	80	76	75	92	90	75	80	80
8	78	78	79	130	50	69	80	66
9	137	75	75	192	90	74	88	68
10	108	53	68	62	184	62	67	60
11	195	99	67	228	181	135	119	167

Experimental Group:

	PRE TEST				POST TEST			
Subject #	BST	L LB	RLB	TF	BST	LLB	RLB	TF
1	120	48	42	115	176	80	88	201
2	89	55	50	60	80	69	75	81
3	162	32	45	107	85	17	40	47
4	137	37	33	211	157	70	65	117
5	61	24	16	124	89	26	23	212
6	85	71	79	71	114	70	56	163
7	136	48	40	213	96	39	50	100
8	95	41	31	59	95	47	42	82
9	73	21	34	116	61	31	46	85
10	121	60	53	151	113	36	50	187
11	93	71	43	50	98	62	42	94
12	132	25	35	54	110	28	45	113

BALANCE DATA

(All numbers have been rounded to the nearest centimeter)

Leg Direction:

F=front, UR=Upper Right, R=Right, LR=Lower Right, B=Back, LL=Lower Left, L=Left, UL= Upper Left

Pre-test Data:

Control Group:

Standing on Left Leg:

	F	UR	R	LR	B	LL	L	UL	Total	Total Ave.	Norm. Score	Ave Norm.
1	73	76	74	79	83	75	67	68	595	74	5.89	0.74
2	87	90	92	100	94	92	92	76	723	90	7.23	0.90
3	88	90	91	96	96	95	84	65	705	88	6.84	0.86
4	73	79	81	82	84	82	80	69	630	79	6.24	0.78
5	82	84	87	87	84	80	70	73	647	81	6.28	0.79
6	81	87	92	101	102	95	79	83	720	90	6.67	0.83
7	78	87	92	99	103	94	78	73	704	88	6.90	0.86
8	82	84	83	88	89	84	79	69	658	82	6.39	0.80
9	79	76	75	78	88	85	76	80	637	80	5.90	0.74
10	84	87	97	113	119	106	89	78	773	97	7.58	0.95
11	81	84	83	83	85	81	65	81	643	80	6.12	0.77
12	81	87	91	95	102	97	88	75	716	90	7.23	0.90

Standing on Right Leg:

	F	UR	R	LR	B	LL	L	UL	Total	Total Ave.	Norm. Score	Ave. Norm.
1	69	64	75	81	87	85	77	75	613	77	6.07	0.76
2	82	81	80	94	103	93	91	87	711	89	7.11	0.89
3	87	82	72	63	100	101	99	94	698	87	6.78	0.85
4	73	67	76	81	87	83	83	80	630	79	6.24	0.78
5	81	71	61	79	87	86	85	83	633	79	6.15	0.77
6	79	76	80	97	105	102	94	87	720	90	6.67	0.83
7	89	79	80	94	95	91	92	90	710	89	6.96	0.87
8	89	79	80	94	95	91	92	90	710	89	6.89	0.86
9	81	75	70	79	84	87	85	84	645	81	5.97	0.75
10	81	77	90	109	118	115	94	81	765	96	7.50	0.94
11	79	71	70	76	80	86	85	87	634	79	6.04	0.75
12	80	76	79	100	105	97	92	87	716	90	7.23	0.90

Experimental Group:
Standing on Left Leg:

	F	UR	R	LR	B	LL	L	UL	Total	Total Ave.	Norm. Score	Ave. Norm
1	71	73	79	83	81	72	70	58	587	73	5.93	0.74
2	79	80	88	89	92	78	69	62	637	80	6.25	0.78
3	70	76	80	85	88	74	61	60	594	74	5.82	0.73
4	71	73	79	84	90	77	78	64	616	77	5.81	0.73
5	74	73	85	91	94	87	77	53	634	79	6.40	0.80
6	71	76	82	96	96	94	75	58	648	81	7.20	0.90
7	75	79	84	91	94	92	76	89	680	85	6.54	0.82
8	74	75	84	92	82	7	70	63	547	68	5.76	0.72
9	67	74	79	81	80	69	58	59	567	71	5.67	0.71
10	65	67	77	72	73	72	68	59	553	69	5.12	0.64
11	83	80	87	90	85	76	71	59	631	79	6.37	0.80
12	65	73	73	80	85	72	61	55	564	71	6.00	0.76

Standing on Right Leg:

	F	UR	R	LR	B	LL	L	UL	Total	Total Ave.	Norm. Score	Ave. Norm.
1	65	59	66	74	84	83	86	79	596	75	6.02	0.75
2	76	68	74	84	84	78	75	77	616	77	6.04	0.75
3	66	65	69	78	86	80	77	74	595	74	5.83	0.73
4	73	64	63	85	93	85	82	79	624	78	5.89	0.74
5	72	63	64	70	95	92	85	80	621	78	6.27	0.78
6	67	59	76	94	98	93	86	76	649	81	7.21	0.90
7	74	72	78	83	88	87	82	80	644	81	6.19	0.77
8	69	57	64	75	81	81	72	68	567	71	5.97	0.75
9	66	57	60	76	80	80	81	76	576	72	5.76	0.72
10	58	53	64	71	66	77	74	76	539	67	4.99	0.62
11	71	59	66	81	96	91	84	77	625	78	6.31	0.79
12	63	60	61	76	81	76	78	77	572	72	6.09	0.76

Post-test Data:
Control Group:
Standing on Left Leg:

	F	UR	R	LR	B	LL	L	UL	Total	Total Ave.	Norm. Score	Ave. Norm.
1	67	70	72	76	83	76	66	65	575	72	5.69	0.71
2	79	87	93	102	98	92	85	77	713	89	7.13	0.89
3	87	89	94	100	106	99	91	71	737	92	7.16	0.89
4	76	81	86	90	96	91	84	69	673	84	6.66	0.83
5	78	87	85	87	90	86	75	70	658	82	6.51	0.80
6	85	89	94	100	104	97	88	89	746	93	6.91	0.86
7	87	90	9	104	107	103	84	80	664	83	6.51	0.81
8	82	85	86	90	99	88	75	77	682	85	6.31	0.79
9	87	88	99	111	110	104	90	78	767	96	7.52	0.94
10	79	83	86	87	85	69	59	63	611	76	5.82	0.73
11	82	87	89	98	102	97	91	76	722	90	7.29	0.91

Standing on Right Leg:

	F	UR	R	LR	B	LL	L	UL	Total	Total Ave	Norm. Score	Ave. Norm.
1	65	56	68	80	83	82	75	72	581	73	5.75	0.72
2	80	79	80	94	99	92	90	86	700	88	7.00	0.88
3	81	75	70	65	107	107	94	89	688	86	6.68	0.83
4	74	68	84	90	96	93	88	80	673	84	6.66	0.83
5	78	72	76	87	90	89	89	84	665	83	6.46	0.81
6	85	83	83	102	109	104	96	90	752	94	6.96	0.87
7	87	80	81	107	114	108	101	97	775	97	7.60	0.95
8	81	71	65	78	95	97	90	85	662	83	6.13	0.77
9	80	78	90	111	115	113	92	86	765	96	7.50	0.94
10	80	67	63	76	85	89	87	84	631	79	6.01	0.75
11	77	77	77	94	104	98	91	85	703	88	7.10	0.89

Experimental Group:
Standing on Left Leg:

	F	UR	R	LR	B	LL	L	UL	Total	Total Ave	Norm. Score	Ave. Norm.
1	70	74	78	82	85	80	70	60	599	75	6.05	0.76
2	88	89	95	99	99	87	75	77	709	89	6.95	0.87
3	72	80	84	89	92	77	67	66	627	78	6.15	0.77
4	71	79	83	88	94	85	73	65	638	80	6.02	0.75
5	64	78	90	100	102	96	86	52	668	84	6.75	0.84
6	76	79	95	104	113	97	82	66	712	89	7.91	0.99
7	76	80	85	94	97	85	75	70	662	83	6.37	0.80
8	79	81	93	99	100	87	79	70	688	86	7.24	0.91
9	71	83	93	96	95	79	71	72	660	83	6.60	0.83
10	73	76	81	82	82	79	77	67	617	77	5.71	0.71
11	73	81	87	96	95	89	74	59	654	82	6.61	0.83
12	71	77	82	89	92	82	57	61	611	76	6.50	0.81

Standing on Right Leg:

	F	UR	R	LR	B	LL	L	UL	Total	Total Ave	Norm. Score	Ave. Norm.
1	65	53	64	75	83	79	80	74	573	72	5.79	0.72
2	82	70	75	87	104	99	96	91	704	88	6.90	0.86
3	72	66	70	84	94	87	83	78	634	79	6.22	0.78
4	69	60	69	88	95	86	85	77	629	79	5.93	0.74
5	68	58	80	97	102	96	85	74	660	83	6.67	0.83
6	75	72	88	106	106	94	92	84	717	90	7.97	1.00
7	74	70	79	92	95	90	86	83	669	84	6.43	0.80
8	71	65	75	84	90	87	86	75	633	79	6.66	0.83
9	74	72	68	85	86	88	84	82	639	80	6.39	0.80
10	69	64	63	76	76	81	82	77	588	74	5.44	0.68
11	71	63	73	90	99	92	83	78	649	81	6.56	0.82
12	70	64	58	86	92	90	84	79	623	78	6.63	0.83

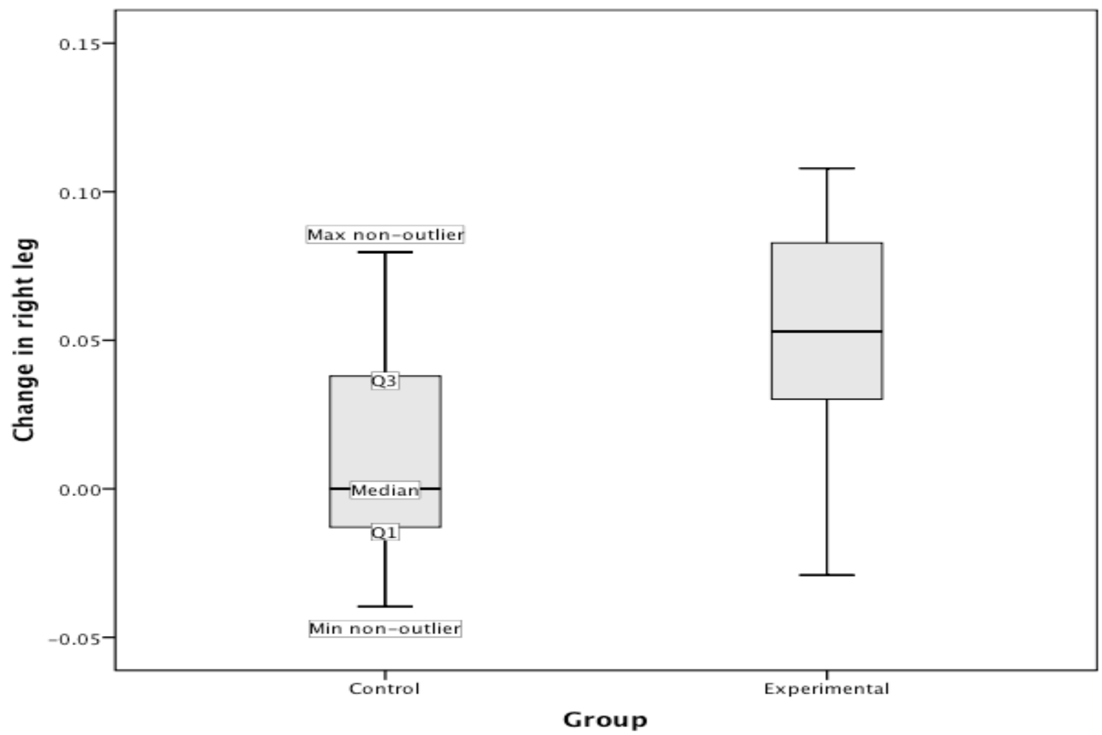

Figure 1. Change in means of left leg

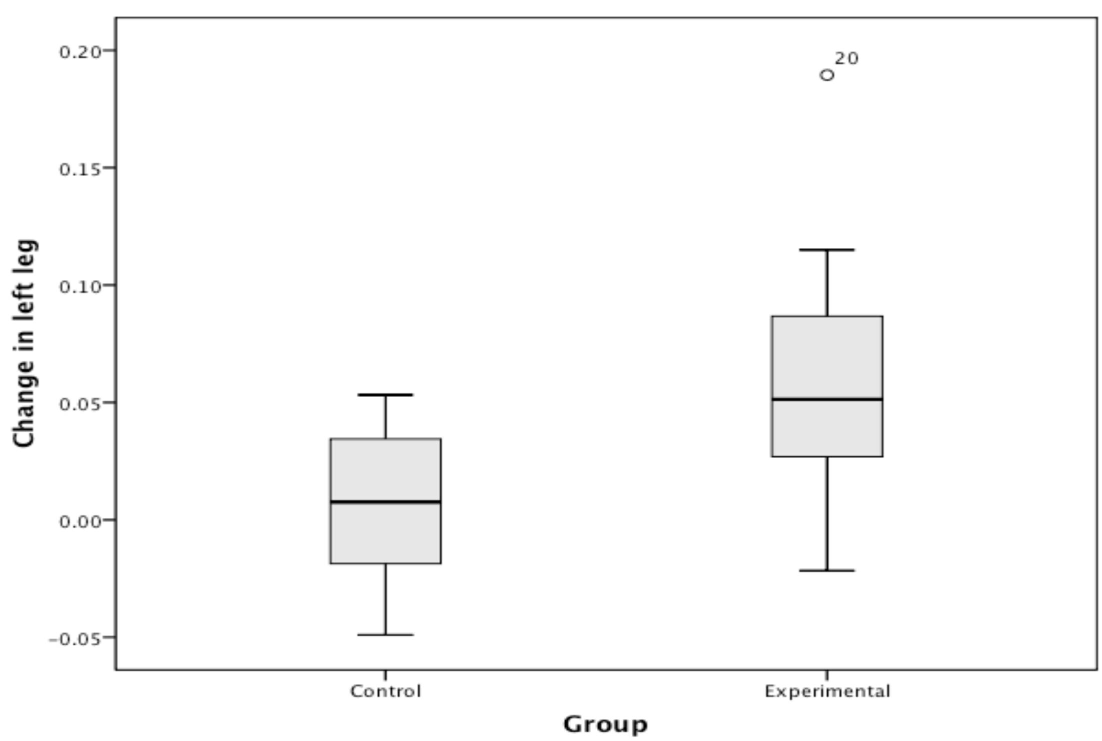

Figure 2. Change in means of right leg

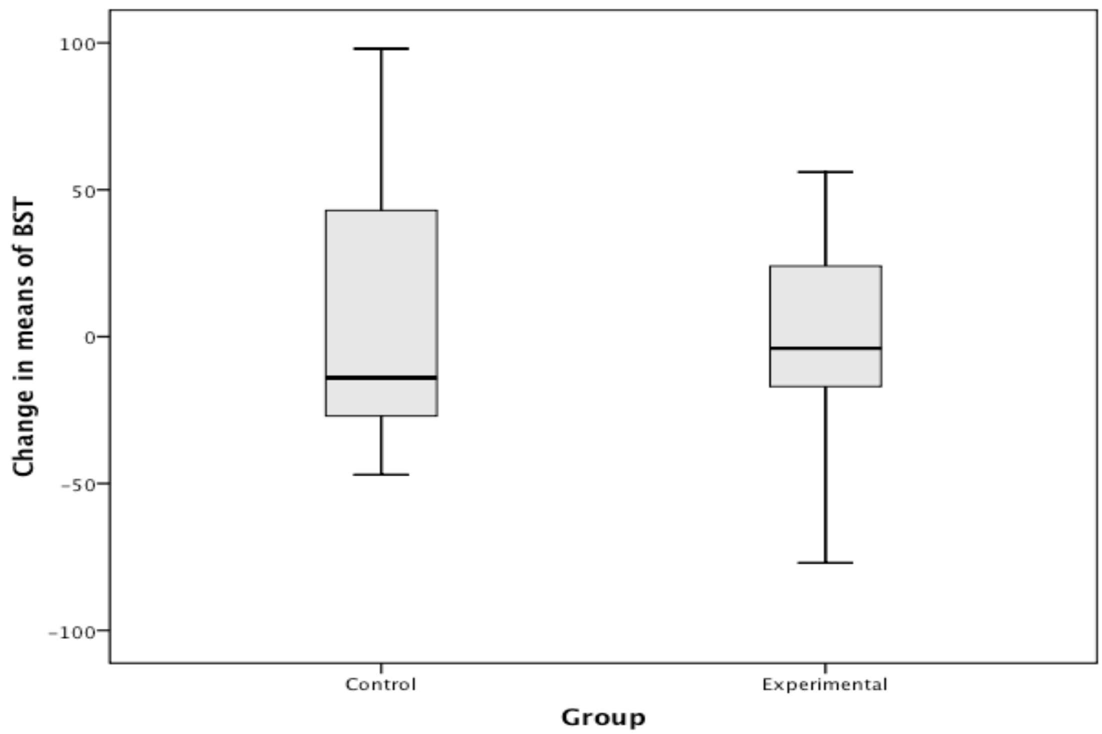

Figure 3. Change in means of Biering-Sorenson test

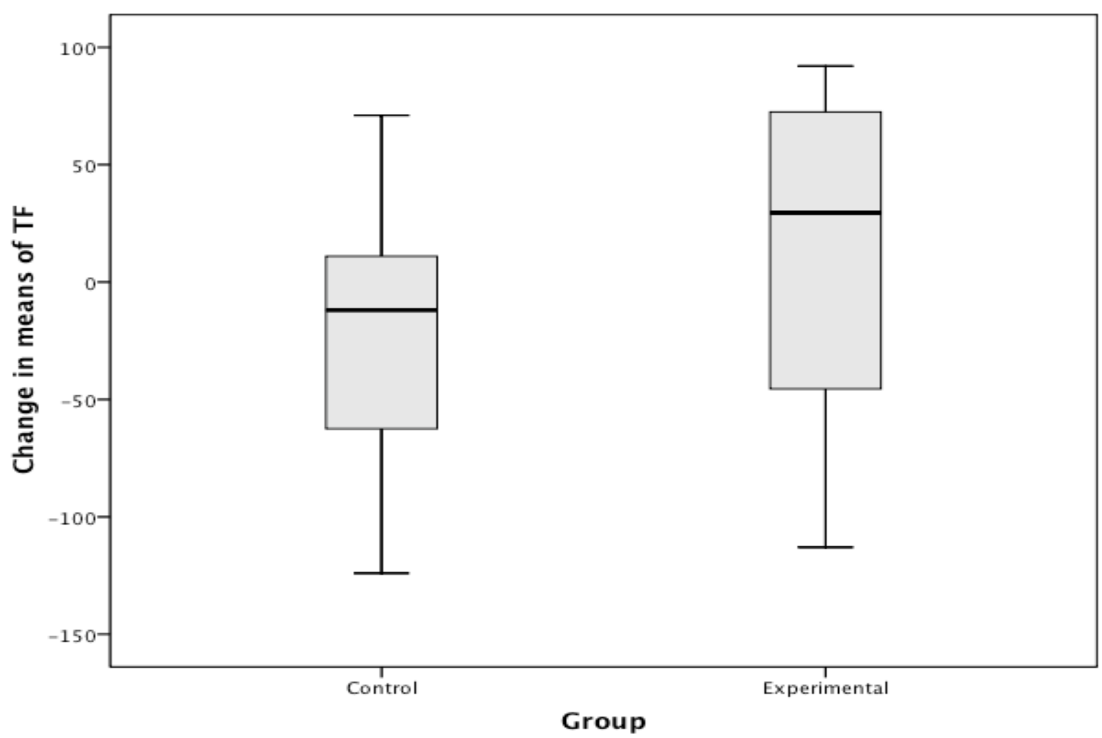

Figure 4. Change in means trunk flexor test

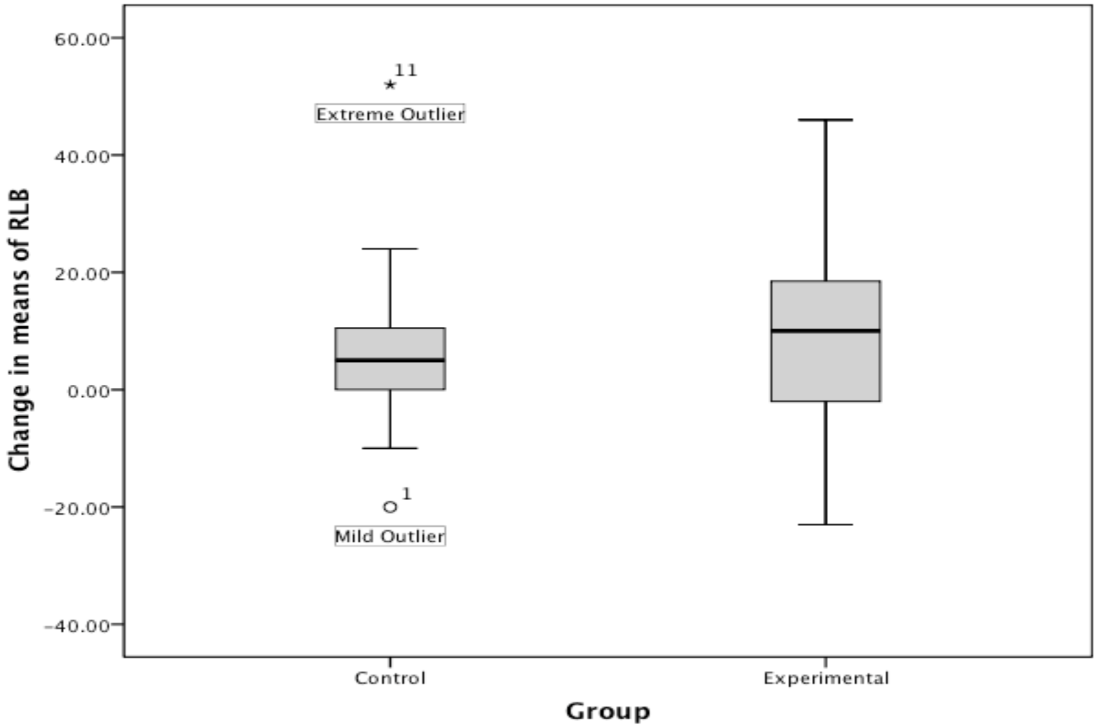

Figure 5. Change in means of right lateral bridges

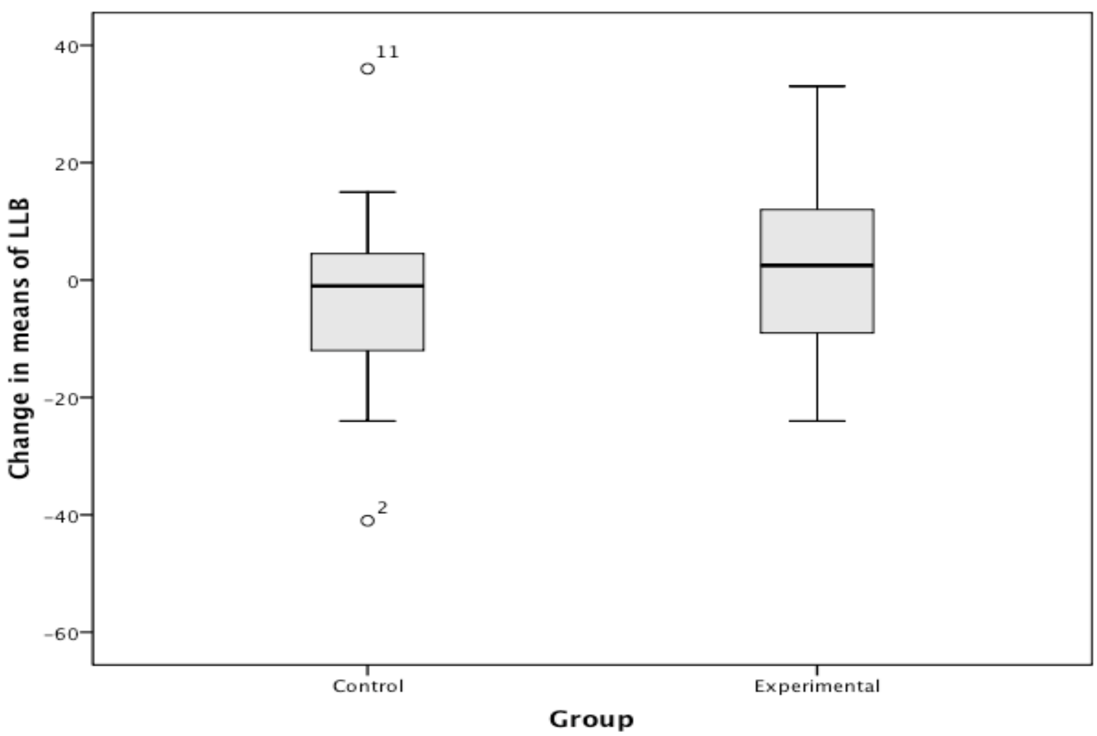

Figure 6. Change in means of left lateral bridges

APPENDIX F
CIRCUS ARTS SAFETY PROTOCOLS

Guidelines for safe slacklining:

Spotting:

When spotting a novice slackliner it is best to have one person support them on each side. The walker can gauge how much assistance they need while walking. If the walker feels very unstable they can use the hands or shoulders of the spotters to support themselves. As the slackliner gets more comfortable and skill increases the spotters will act like they are spotting a participant on a low traverse element on a ropes course. The same principles such as a good athletic stance, having hands up ready to catch a fall and an awareness of the surroundings apply when spotting for slacklining.

Line Set-up:

When setting up a slackline keep in mind the area around the line. Clear the area of any and all objects that could be hazardous to the slackliner or to the slackline. Keep the height of the line low to the ground, having the middle of the slackline about twelve inches off the ground when some one is standing on it.

General Safety:

Be aware of where you are in relation to the slackline, because the line is dynamic a fall could create a rapid change of position of the line and cause injury to a participant or bystander if they come in contact with the pulley system.

APPENDIX G
SLACKLINE SET-UP INFORMATION AND TEACHING GUIDE

Safety:

Slacklining can be performed in a very safe and low risk environment, as long as an instructor takes the proper steps to teach spotting first. Once spotting is taught (the same type of spotting for climbing) it can then be modified for slacklining. In the beginning have one person walking the line and two people spotting on either side of the slackline. Another tool that I have used in the skill progression is to have a fourth person sit on the slackline at one end. This will put more tension in the system, making it easier to walk and will lower the line a bit to make it a bit easier for students to get on. The walker can choose how much they would like to use the spotters (ie. If the walker wanted to hold on to the hands or shoulders of the spotters to balance themselves while walking that would be ok). As walkers feel more confident in their skills they can have the spotters take a more preventative approach, where the spotters are there to assist a walker if they fall (the spotters job would not be to prevent the fall but to make sure that the walker lands safely on the ground (feet, butt, etc. NOT head/neck/back). With more practice the walker can then move to having either one or no spotters (this is something that either the teacher can control or have the students gauge what they feel comfortable with)

The height of the slackline can very but traditionally I have set up the line about 2.5-3ft off the ground. Other things the be aware of are that a slackline is a dynamic system so make sure not to have people near the carabiners or the line, a walker can "flex" the line in a fall which results in movement of the line and could hit others if people are too near the slackline.

Equipment:

For one slackline a gap of about 25ft is recommended (this can be shorter or longer)

(about $0.30/ft)

75Ft of 1"tubular webbing (walking line)

12Ft of 1" tubular webbing (anchor line) (tied in a loop with a water knot)

3 Oval Carabiners (about 5-7 dollars)

Two links of chain that are 3/8" (a clove hitch or girth hitch can be used in place of these)

The amount of people using one line can be up to the instructor but I have found that for a class of 20 about 3 lines works well.

Set Up:

Start with the end of the walking line, attach a carabiner to the end using a clove hitch or girth hitch. Wrap that end around a tree pole etc. and clip it back into the walking line (this gives you the first anchor point). Next attach the anchor line (the shorter piece of webbing to the other tree,pole,etc. with a girth hitch (wrap the webbing around the tree and put it back through itself)this becomes your other anchor point. The tension system is next, go back to the walking line and extend it towards the second anchor point, stop about 7 feet from the second anchor point tie a girth hitch around a carabiner that becomes the first part of the pulley system. From that carabiner run the webbing to the second anchor and attach with a carabiner. From here run the webbing back to the first carabiner and clip it in. at this point you will have made a loop from the girth hitch to the second anchor point. Repeat this one more time BUT put this loop inside the first loop. This will lock the pulley system so it will not loosen up while walking. To tighten just pull on the extra webbing away from the first anchor, to loosen (break down) put the extra end towards the first anchor.

Additional notes:

This activity is one where the student can be creative, having strict guidelines for what they need to do could be a turn off for some students, instead have things that the students can try if they are interested, use the internet and have them look at different ways to rig a slackline and have them youtube.com different tricks to try during class, this is a great activity were incorporating technology can be very easy.

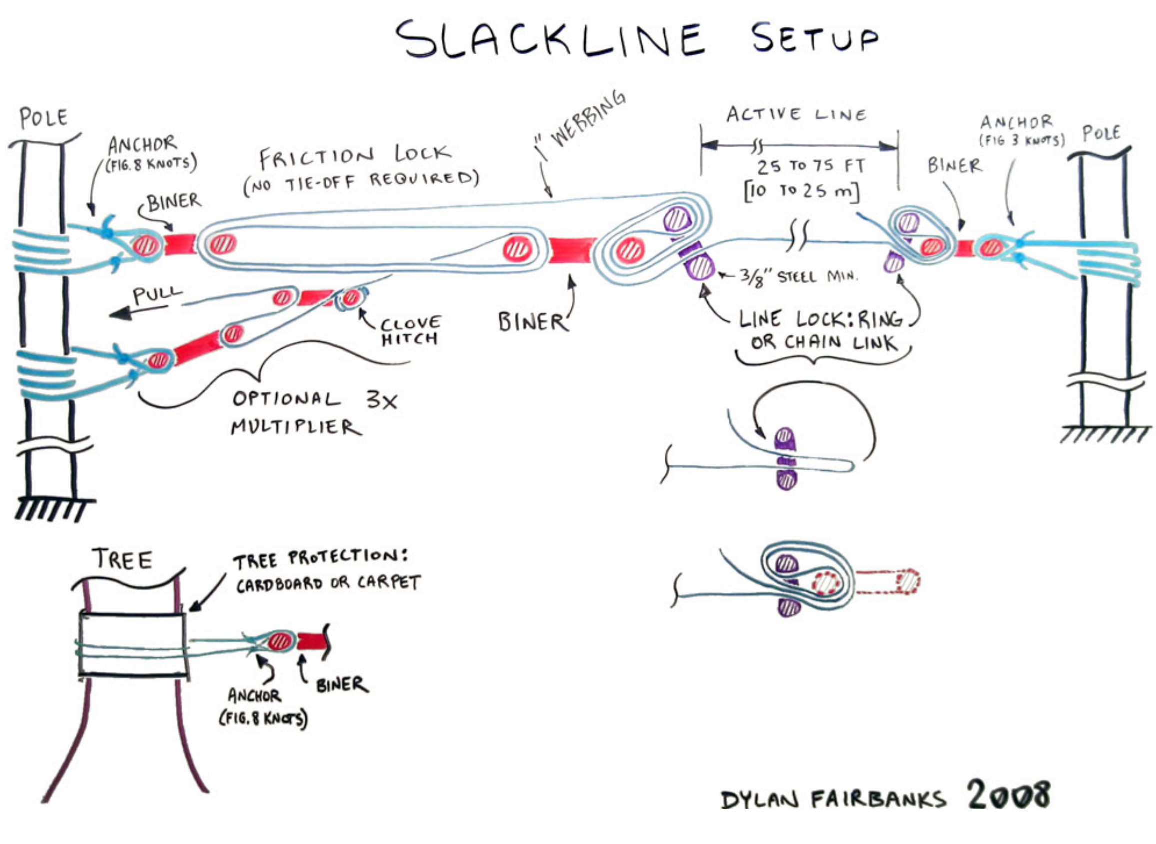

Figure 7: Simple “primitive” slackline set-up