Effects of Self-Controlled Feedback on the Squat

by

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Abstract

The purpose of the present study was to compare motor skill acquisition between two learning environments; an environment in which learners determined the type of feedback they received, and one which was controlled by the researcher. Fourteen female and 10 male college aged participants were randomly divided into 2 groups. Participants practiced the squat on two different days. One group was permitted to choose the type of feedback (video feedback or verbal feedback) they would receive following each feedback trial, while the other was not. They were tested at various times (initial test, mid test, post test, retention test) in order to determine the degree of their improvements in squatting form. The main finding of the study was that while both groups improved throughout the course of the study, there were no group differences on any of the four tests. It was concluded that allowing learners to determine the type of feedback they received as they learned the squat did not benefit them significantly more than not giving them control over feedback type.

Preface and Acknowledgements

I would like to start by thanking the students who gave their time to serve as participants within my study, as well as their instructors, who allowed me to provide them with the opportunity to participate. I would also like to thank those who had a hand in making various facilities available for use. I would like to extend my gratitude to my thesis committee; Dr. Joy Hendrick, chair, Dr. Peter McGinnis, and Dr. Philip Buckenmeyer for their role in making the portion of my education spent at SUNY Cortland both enjoyable and successful, as well as their guidance in the completion of this culminating project. I am especially grateful to my mother, without whom I would not have had the opportunity to begin this project, and my committee chair, Dr. Joy Hendrick without whom I would not have finished it.

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Chapter 1

Introduction

Feedback has been shown to aid in the learning of motor skills (Rothstein, 1980). While learners obtain certain pieces of feedback on their own, they can also be supplemented with feedback provided from an external source, also referred to as augmented feedback (Schmidt & Wrisberg, 2008). It is often out of the hands of learners as to whether or not they are provided with augmented information during specific times throughout the learning process. The prospect of giving learners control over whether or when they receive such information, has often been overlooked (Chiviacowsky, Wulf, de Medeiros, Kaefer, & Tani, 2008).

While only a limited number of motor learning studies have looked at the effectiveness of allowing learners to control some aspect of the learning environment (e.g. self-control or learner-control), most have shown self-control to be beneficial. The benefits of self-control have been shown in terms of feedback frequency, other feedback related variables, frequency at which a model is viewed, and frequency at which an assistive device is used (Chen, Hendrick, & Lidor, 2002; Chiviacowsky & Wulf, 2002; Chiviacowsky & Wulf, 2005; Chiviacowsky et al., 2008; Janelle, Kim, & Singer, 1995; Janelle, Barba, & Frehlich, 1997; Titzer, Shea, & Romack, 1993; Wulf, Raupach, & Pfeiffer, 2005; Wulf & Toole, 1999; Wulf, Clauss, Shea, & Whitacre, 2001). There are still a number of areas for which the benefits of self-control have not yet been investigated (Chiviacowsky et al.).

Video feedback is one type of augmented feedback which allows the learner to watch his/her performance on video tape, in order to correct errors and foster learning

improvements. Some video feedback studies have shown it to be beneficial for learning motor skills (Del Rey, 1971; Guadagnoli, Holcomb, & Davis, 2002; Neufeld & Neufeld, 1972; Oñate, Guskiewicz, Marshall, Giuliani, Bing, & Garrett, 2005; Selder & Del Rolan, 1979; Watkins, 1963), while others have found it to be no better (or even worse) than traditional feedback as provided by an instructor (Emmen, Wesseling, Bootsma, Whiting, & Van Wieringen, 1985; James, 1971; Kernodle, Johnson, & Arnold, 2001; Penman, Bartz, & Davis, 1968; Sim & Stewart, 1984; Van Wieringen, Emmen, Bootsma, Hoogesteger, & Whiting, 1989). At any rate, the efficacy of video feedback is subject to debate.

In order for video feedback to have the best chance of being effective, three specific factors have been identified. For one, important aspects of video replays should be pointed out to learners (Boyce, Markos, Jenkins, & Loftus 1996; Darden & Shimon, 2000; Rothstein & Arnold, 1976.) Secondly, learners should be of an appropriate skill level (Darden & Shimon, 2000; Kernodle et al., 2001; Rikli & Smith, 1980; Selder & Del Rolan, 1979). Lastly, video feedback should be employed often enough to have a positive effect on learners' performance (Darden & Shimon, 2000; Rothstein & Arnold, 1976).

If video feedback is employed properly, it seems plausible that it should provide learners with relevant information that they are not getting elsewhere (Rikli & Smith, 1980). It is apparent that the same could be said for verbal feedback, also a form of augmented feedback. If this is the case, the type of augmented feedback (video or verbal) which provides the learner with the best information should result in the greatest amount of learning.

One reason learners benefit from self-control is because it provides them with relevant information when it is needed (Chiviacowsky & Wulf, 2002, 2005). While the efficacy of allowing learners to control various experimental variables has been shown, it seems that no self-control study has investigated the efficacy of allowing learners to choose the type of feedback they receive on trials when feedback is employed. If video feedback and verbal feedback provide different pieces of augmented information to learners, it seems that one of these types of feedback could be more valuable than the other at certain times and vice versa. The efficacy of self-control, could therefore, be investigated by allowing learners to choose the type of feedback that provides them with the information they feel they need following each feedback trial.

The squat exercise plays an important role in the conditioning of athletes (Escamilla et al., 2001; Escamilla & Krzyzewski, 2001; Walsh, Quinlan, Stapleton, FitzPatrick, & McCormack, 2007; Wretenberg, Feng, & Arborelius, 1996). Perhaps this is because it resembles so many movements within sport (Escamilla et al., 2001; Escamilla & Krzyzewski, 2001; Lander, Bates, & Devita, 1986). There is concern however, as to potential for injury during its performance (Lander et al., 1986). This potential for injury can be minimized by maintaining proper squatting form (Chandler & Stone, 1991; Escamilla & Krzyzewski, 2001; McLaughlin, Dillman, & Lardner, 1977). Consequently, teaching proper form to those who are new to the squat is very important. Therefore, it is an ideal skill to use in the investigation of the efficacy of self-control.

Problem Statement

The purpose of this study was to compare motor skill acquisition between two learning environments, a motor control environment in which learners determined the type of feedback they received, and one which was experimenter-controlled.

Hypothesis

It was hypothesized that the learning environment which allowed learners to determine which type of feedback they received would result in greater learning than the learning environment which did not.

Operational Definitions

Augmented Feedback (AF): Feedback that is given in addition to information the performer obtains through the senses. AF can be given verbally, through video, or by other means.

Dartfish: A computer software program which is designed to analyze and replay video clips (http://www.dartfish.com/en/index.htm).

Experimental Group: A group within a study that receives the treatment which the study is employing, and evaluating. In this study the experimental group (which was called the self-control group) was given the ability to choose the type of feedback (video feedback or verbal feedback) they would receive following feedback trials.

Inherent Feedback: Feedback that the performer gains on his/her own through the senses.

Intrinsic Feedback: Same as Inherent Feedback

Knowledge of Performance (KP): Augmented feedback which is given after the completion of a motor skill, that tells the learner the degree to which he/she has maintained proper form while performing the skill.

Knowledge of Results (KR): Augmented feedback which is given after the completion of a motor skill, that tells the learner the degree to which he/she has achieved the desired goal of that motor skill.

Learner-Control: Same as self-control

Windows Movie Maker: A computer software program which comes standard with Microsoft Windows (operating system) that is designed to capture and play videos.

Self-Control: Allowing learners to control some aspect of the learning environment.

Video Feedback: A type of augmented feedback in which a performer watches his/her own performance on video tape to gain insights about some aspect of performance.

Video Model: A performer (usually an expert) who has been videotaped so that his/her performance can be used to demonstrate a motor skill.

Yoked Group: A group, each of whose participants is matched with a participant of an experimental group in terms of the dependent variable. In this study, feedback will be given following pre-determined feedback trials. Following each feedback trial, participants from the experimental group will choose the type of feedback they will receive for that particular trial. Each participant from the yoked group will receive the same type of feedback (following each feedback trial) as was previously chosen by his/her counterpart from the experimental group.

Assumptions

It was assumed that :

1. Participants would demonstrate maximal effort during testing and practice.
2. All critical aspects of a successful squat had been identified.

Limitations

This study was limited in that:

1. Participants were provided with descriptive KP rather than prescriptive KP.
2. KP was only provided based on the most recent trial. It was not given as summary KP.
3. The researcher had no control over the number of video feedback and verbal feedback trials.

Delimitations

This study was delimited to the following:

1. The participant population consisted solely of college students.
2. It used unskilled learners.
3. It employed a set frequency of KP. On the first day of the study, participants received KP following every second trial. On the second day of the study, participants received KP following trials 3, 6, and 9 from each set of ten trials.
4. It employed the squat as the skill of choice. The goal for participants was to learn proper squatting form.

Chapter 2

Literature Review

The first portion of this chapter contains a review of literature pertaining to self-control. The following aspects of self-control will be discussed: a) efficacy of self-control, b) various types of studies which employed self-control in terms of feedback, c) studies which allowed learners to control the use of assistive devices, or the frequency at which they viewed a video model d) studies which lack support for the efficacy of self-control, and e) explanations for the benefits of self-control.

The second portion of this chapter contains a review of literature pertaining to video-feedback. Studies are broken down into three sections: a) support for the effectiveness of video feedback, b) lack of support for the effectiveness of video feedback, and c) video feedback studies which provide mixed results as to its efficacy. At the end of each section, the studies therein are compared based on various points: 1) guidance of video feedback, 2) skill level of learners, 3) frequency of video feedback employment, and 4) type of improvements shown as a result of video feedback. These points are then discussed further in terms of their importance in the effective employment of video feedback. Lastly, the prospects involved in allowing learners to choose between video and verbal feedback are discussed.

The third portion of this chapter contains information pertaining to the squat. Information is broken down into two sections: a) safety implications for squat performance, and b) proper form for the squat. These are important factors to consider in learning the squat.

The Efficacy of Self-Control

The efficacy of self-control (i.e. learner-control), allowing learners to control various aspects of the learning environment, has been showcased by number of motor learning studies. Many motor learning studies in the area of self-control examined the efficacy of giving learners control over their schedule of feedback or other feedback related variables (Barney & Lee, 2007; Chen et al., 2002; Chiviacowsky & Wulf, 2002, 2005; Chiviacowsky et al., 2008; Janelle et al., 1995; Janelle et al., 1997; Titzer et al., 1993). Others looked at the effects of allowing learners to control the schedule according to which they viewed a video model (Wrisberg & Pein, 2002; Wulf et al., 2005), or used assistive devices (Wulf & Toole, 1999; Wulf et al., 2001). Only a few studies found that allowing learners to control certain aspects of the learning process was no more effective than controlling these aspects for them (Barney & Lee, 2007; Wrisberg & Pein, 2002). Despite the efficacy of self-control, there are a number of variables related to the learning process for which its merits have not yet been explored (Chiviacowsky et al.).

Self-Control of Feedback (Computer Based Studies)

A study by Titzer et al. (1993) serves to make a case for the efficacy of self-guided feedback. This study compared a group which received self-controlled feedback to two other groups (one which received feedback in blocks, and one which received feedback randomly) as they attempted to acquire proficiency in a computer-controlled barrier task. During an immediate retention test, the group that had control over their feedback schedule significantly outperformed the other two groups in terms of movement time. This group also significantly outperformed the blocked feedback group in terms of reaction time. Additionally, the authors affirmed that research on learner performance in

computer-based instruction may be affected positively by increasing the learner's control over the learning process (Titzer et al.).

Chen et al. (2002) required participants to press five keys on a computer keyboard, in a prescribed order, in less than 800 ms. The self-initiated knowledge of results (SI-KR) group was permitted to request feedback at the end of each trial, if they so chose. The (EI-KR) experimenter-induced knowledge of results group was permitted to do the same, but in addition, at the end of each trial, the experimenter reminded them of this option. A third group was yoked to the SI-KR group, and a fourth group was yoked to group EI-KR group. The results of an immediate retention test, and a retention test that was given two days following acquisition showed that the SI-KR and the EI-KR groups performed more accurately than the other two groups. The authors suggested that a side effect of a learning style that is self-regulated may be the development of learning strategies that are more effective than a rigid feedback setting could accomplish. They also affirmed that their study, combined with previous research is a showcase for the advantages of an environment that is controlled by the learner (Chen et al.).

While the goals of the previous study were speed (to a certain degree) and accuracy, Chiviacowsky and Wulf (2002) employed a computer keyboard task, which required participants to press four keys (specifically 2, 4, 8, and 6), with appropriate timing between key presses (specifically 200, 400, and 300 ms respectively). During the last block of acquisition trials, the yoked group outperformed the self-control group by a significant amount in terms of relative timing errors. For the one-day-delayed, no feedback retention phase of the study, there were no group differences. Both groups showed decreases in performance on the transfer test, which required them to time their

key presses differently than in acquisition and retention (specifically 300, 600, and 450 ms respectively between key presses). However, the self-control group showed significantly smaller decreases. Results of this study also showed that participants in the self-control group preferred to request feedback following trials in which they had performed successfully, as opposed to unsuccessfully. Most importantly, the researcher's primary hypothesis, that self-controlled practice tends to cater to the needs of learners (more so than experimenter-controlled practice), was supported. Based on this contention, Chiviacowsky and Wulf conducted a follow up study in 2005, which provided additional support for their previous findings as well as some additional insights as to the efficacy of self-control.

Self-Control of Feedback (Tossing and Throwing Studies)

Chiviacowsky et al. (2008) looked at the efficacy of self-control in ten-year-old children. Participants were required to toss (overhand) beanbags at a target that was positioned on the floor at a distance of three meters away without the aid of visual feedback. Feedback (when requested or given) during the 60 trials of acquisition informed participants whether their throws were long, short, right, left, far, or near, in terms of the target. The self-control group received feedback following trials after which it was requested. Each participant in the yoked group was yoked to a participant from the self-control group in terms of feedback scheduling. Results indicated that the self-control group significantly outperformed the yoked group in terms of accuracy during a ten trial, no-feedback, retention test which was held on the day following acquisition. The findings of the study provide insights as to the efficacy of self-control in children, as well as support for the efficacy of self-control in general (Chiviacowsky et al.).

Janelle et al. (1995) employed five groups in order to examine the effects of allowing learners to determine feedback frequency. The control group did not receive KP, the performance summary group received summary feedback after every five trials, and the fifty percent group received feedback after every other trial. The subject-controlled group received feedback whenever they requested it, and each participant from the yoked control group was yoked to a participant from the subject-controlled group.

The goal for participants, was to underhand-toss a golf ball, so that it landed and rolled down a turf runway, into the center of a target that was 183 cm away. Feedback was given based on technique. It indicated whether participants tossed the ball too hard or too soft, with too much or not enough loft, whether their arm swing moved from left to right or right to left (instead of going straight), or whether they had performed a good throw in terms of technique.

There were no differences between groups during acquisition, but the subject-controlled group performed with a greater degree of accuracy than the other four groups during retention. The authors acknowledged the possibility that allowing learners to control their environment is optimal for instruction (Janelle et al.).

In a follow up study, Janelle et al. (1997) required participants to perform a non-dominant hand throw at a 1 m x 1 m target that was 9 m away. Throwing accuracy was deemed important by the authors, but the main focus was on displaying proper form. One group for this study did not receive KP. A second group received KP after every five trials. A third group received KP whenever requested. Each member of a fourth group was matched to a member of the third group.

During retention, the group that received KP whenever requested performed consistently better than the other groups, and the group which didn't receive KP performed consistently worse than the other groups in terms of form. The authors concluded that when learners are permitted to control their feedback environment, they can learn at a level equal to or higher than learners whose feedback schedule has been chosen for them. Additionally, self-control bolsters their retention (Janelle et al.).

Self-Control Use of Assistive Devices

Wulf and Toole (1999) looked at the effects of allowing the learner to determine when to use, and when not to use an assistive device in learning a motor skill. The goal was for participants to achieve optimal performance on ski simulator, by repeatedly sliding from left to right and back, as far as possible, during a 90-second interval. On various trials, participants were provided with ski poles, which aided their balance, and were designed to facilitate learning of the skill. Participants in the self-control group were permitted to use the ski poles whenever they chose except during retention. Each participant in the yoked group was matched to a participant in the self-control group.

The self-control group showed improved performance during retention, while the yoked group showed a decrease in performance. The authors pointed out that giving learners the choice as to when they would use the poles benefited their learning. They also noted that their results make a case for the efficacy of allowing learners to dictate certain aspects of the learning process. This study was different from previously conducted studies, because it allowed learners to influence how they went about learning a motor skill (Wulf & Toole).

In a follow up study, Wulf et al. (2001) employed the same methods as Wulf and Toole (1999), with one difference. In addition to performing the trials on the ski simulator, each participant in the self-control group observed his counterpart from the yoked group as he/she performed the trials and vice versa. It was found that groups performed similarly in terms of movement amplitude and frequency during acquisition (possibly as a result of the competition aspects of watching a counterpart perform the skill). However, the self-control group displayed a movement pattern that was non-significantly more efficient during acquisition, and significantly more efficient during retention. This makes a case for the efficacy of self-control, even in dyad practice (Wulf et al.).

Self-Control of Video Modeling Frequency

Wulf et al. (2005) required participants to learn a basketball jump shot from the free throw line (with form and accuracy as the main goals). However, it was different from many other studies in that the dependent variable was the frequency at which learners could view a model which they were told to emulate (in terms of form). The self-control group could watch the video model at any time they chose during practice, while each participant from the yoked group was paired with a participant from the self-control group in terms of the schedule according to which they viewed the model. Groups were similar in terms of form and accuracy scores during practice, and accuracy scores during retention, but the self-control group's retention scores were significantly higher in terms of form. Given the dependent variable (emulation of the model's performance), it made sense to the researchers that form in retention was the only affected variable. They noted that results from this and other studies indicate that self-

controlled practice results in better information processing on the part of the learners, and the extraction of a greater amount of salient information (Wulf et al., 2005).

Wrisberg and Pein (2002) examined the frequency at which participants viewed a video model. For this particular study, participants performed the badminton long serve. The goal was to serve the birdie as deep into an opponent's service court as possible. The study used three groups. One group viewed the model after every attempt. A self-control group was given the choice of whether or not to view the model after each attempt. A third group was not permitted to view the model.

During acquisition the self-control group was significantly more accurate than the group that did not view the model. On day three of acquisition, as well as during retention, the group that was not permitted to view the model performed significantly worse than the other two groups in terms of form. This study failed to make a strong case for the effectiveness of allowing learners to control various aspects of their learning environment. Nevertheless, the authors still indicated that their study's results suggest that it might be beneficial (in terms of instructional efficiency) to allow learners to control how often they receive assistance in learning (Wrisberg & Pein).

Lack of Support for Self-Control

The results from Wrisberg & Pein (2002) do provide some support for the effectiveness of self-control. After all, acquisition performance of the self-control group was significantly more accurate than that of the group that was not permitted to view the model. However, these results did not carry over into retention, thus showing less than impressive effects on permanent learning.

While the self-control group had significantly better form than the group that was not permitted to view the model during the third day of acquisition as well as during retention, so did the group that viewed the model with 100% frequency (Wrisberg & Pein). The fact that a 100% feedback frequency has been shown to be less than optimal (Wulf, Schmidt, & Deubel, 1993; Wulf, Lee, & Schmidt, 1994) further indicates that self-control was not incredibly effective in the case of Wrisberg and Pein (2002).

A study conducted by Barney and Lee (2007) was similar to the one by Wrisberg and Pein (2002) in that it did not conclusively find self-control to be the best treatment. Participants used a mouse to control a cursor which moved horizontally in order to intercept a circle which dropped from the top of a computer screen. The study employed three groups. One received feedback based on the best trial from each set of three trials, another received feedback on the worst trial per set of three trials, and the last chose the trial (per set of three trials) that they would receive feedback on. The worst-trial group outperformed the other two groups in terms of "overall trial performance" and in terms of the accuracy of their movements during retention. Unlike Wrisberg and Pein (2002), they provided an example where the self-control group actually performed worse than another group in a motor learning study (Barney & Lee). It should be considered that groups within this study were equated based on feedback frequency. It was different from most other self-control studies in this respect.

Possible Explanations for the Benefits of Self-Control

A number of studies have been able to gain further insights as to possible reasons for the efficacy of self-control. Wulf et al. (2001) found that retention performance differences between groups in regard to the goal of the learners was negated through

inherent competition which resulted from dyad practice. However, the self-control group displayed more efficient performance on a less observable variable in their movement pattern (relative force onset). Possibly their self-efficacy encouraged them to search for the best way to perform the task (Wulf et al.).

Chiviacowsky and Wulf (2002) found that learners preferred to receive feedback after trials on which they had performed successfully. Additionally their primary hypothesis that self-controlled practice tends to cater to the needs of learners more so than experimenter-controlled practice, was supported. Their 2005 follow up study, looked further into these contentions. Its methods were the same as their 2002 study except that it compared its two groups in a slightly different way. Both groups received feedback after the trials of their choosing (with the stipulation that feedback had to be requested on 3 out of every 10 trials). The difference between groups was that when one group made the decision to receive feedback after the trial, it was made following the trial, while the other group had to make this decision before the beginning of the trial. This eliminated the latter group's ability to make the decision to receive feedback based on previous performances.

They found no significant differences between groups during acquisition or retention. However, the group that decided before the trial regressed significantly more during a transfer test, thus indicating that the other group was better able to cope with the different timing demands imposed on them during transfer. The researchers indicate that these results were likely a product of the ability to base the request for feedback on how they performed on a previous trial, as well as the resultant error estimation process they employed. Of secondary importance was that this study supported previous findings in

that it found that learners preferred to receive feedback after successful trials as opposed to unsuccessful ones (Chiviacowsky & Wulf).

Among the possible explanations for the benefits of self-control are that it could help encourage participants to try new ways to perform a task, thus leading to improved performance (Wulf et al., 2001). Learners also receive feedback when they need it (Chiviacowsky & Wulf, 2002; Chiviacowsky & Wulf, 2005), and they possibly employ information processing activities that are more effective (Wulf & Toole, 1999). The motivational aspects of self-control have also been attributed as a possible reason for its efficacy (Chen et al., 2002).

Research has supported the efficacy of allowing the learner to control various aspects of practice, such as feedback frequency or other feedback related variables (Chen et al., 2002; Chiviacowsky & Wulf, 2002, 2005; Janelle et al., 1995; Janelle et al., 1997; Titzer et al., 1993), when they viewed a model (Wulf et al., 2005) and the use of assistive devices (Wulf & Toole, 1999; Wulf et al., 2001). Chiviacowsky et al. (2008) even found that the benefits of self-control may generalize to children. It should be noted however, that many aspects of self-control in motor learning have not yet been examined (Chiviacowsky et al., 2008). Included in these is the effectiveness of allowing the learner to control the type of feedback he/she receives.

Video Feedback and Factors Influencing its Efficacy

An important role in motor skill learning is carried out by feedback (Rothstein, 1980). The two prominent types of feedback are intrinsic feedback and extrinsic feedback. Intrinsic (also referred to as inherent) feedback is obtained through the senses, and occurs naturally, without additional input from outside sources. Extrinsic (also

referred to as augmented) feedback is given in addition to intrinsic feedback. It is provided to the learner from a source other than himself/herself. Extrinsic feedback gives the learner information that he/she could not have gained through intrinsic feedback alone (Schmidt & Wrisberg, 2008).

Augmented feedback is a necessity for effective learning of certain motor skills (Magill, 1994). It can be given in a variety of forms including visual or verbal demonstrations by an instructor, or through more technological means. One type of augmented feedback, video feedback, has been shown to be effective in improving the learning of motor skills (Darden, 1999; Darden & Shimon, 2000; Rothstein, 1980). However, the research that has been conducted on video feedback has produced less than consistent findings in terms of its benefits (Boyce et al., 1996; Rothstein & Arnold, 1976).

Although its efficacy is far from guaranteed, certain things can be done in order to make video feedback more effective. Given the fact that video feedback is a form of augmented feedback, it seems apparent that like other forms of augmented feedback, it will work best if it provides information that is not already obvious to learners. According to Rikli and Smith (1980), video feedback will likely be more effective if it provides participants with information that is difficult for them to obtain inherently.

However, providing learners with information that is not easily obtained during performance is not enough. After all, when receiving video feedback, learners often tend to direct their attention to movement outcomes, thereby overlooking important technical aspects of the skill (Darden & Shimon, 2000). Without guidance they may not focus on the most important aspects of the skill (Del Rey, 1971). One of the greatest points of

agreement between researchers is that in order for video feedback to be effective, learners need to be directed to relevant aspects of their performance as they watch replays (Boyce et al., 1996; Darden & Shimon, 2000; Rothstein & Arnold, 1976). This can be done through the use of checklists (Oñate et al., 2005), verbal guidance from the instructor (Darden & Shimon, 2000; Rothstein, 1980), or through other means (Del Rey, 1971).

Another factor affecting the usefulness of video feedback is the skill level of the learners. Many researchers indicate that video feedback is less effective for learners in the cognitive stage (beginner level performers), than those with more experience (Darden & Shimon, 2000; Kernodle et al., 2001; Rikli & Smith, 1980; Selder & Del Rolan, 1979). However, this does not mean that video feedback is totally ineffective for inexperienced learners (Del Ray, 1971; Neufeld & Neufeld, 1972). Additionally feedback is affected by the relative complexity (complexity of the skill in relation to the ability of the learner) of the skill that is being learned (Guadagnoli et al., 2002). Perhaps this is also an important factor in accounting for the efficacy of video feedback.

Another factor influencing the effectiveness of video feedback is how often it is employed during the learning process. Video feedback must be employed often enough in order for it to be effective (Darden & Shimon, 2000; Rothstein & Arnold, 1976). Although Darden and Shimon (2000) do not give specifics, they mention that research on video feedback indicates that a lengthy period of time is required to give it the best chance of being more successful than traditional instruction methods.

Support for the Effectiveness of Video Feedback

A number of studies have found video feedback to be effective. Watkins (1963) examined improvements in 20 varsity baseball players who underwent 5 weeks of regular

batting practices. The experimental group for this study was supplemented with (verbally guided) video feedback as a group, when batting errors were pointed out on one day of each week. During this time, each participant received three minutes of video feedback based on his own performance. This was enough for the experimental group to improve significantly more than the control group (which did not receive the video treatment) in terms of decreasing their mean number of batting faults (Watkins).

Guadagnoli et al. (2002) examined the efficacy of video feedback for experienced participants. This study compared three groups, all of which went through four, 90 minute training sessions. Groups included a video group (which received both video and verbal feedback), a verbal group (which received verbal knowledge of results), and a self guided group (which simply practiced on their own). Participants were required to use a 7-iron to hit golf balls as far as possible along a straight line. The most pertinent findings were that the video group performed significantly better than the other two groups in terms of accuracy distance (total distance in the intended direction minus deviation to the right or left of the straight line), total distance, and distance variability, as measured in a two-week delayed post-test (Guadagnoli et al.).

Selder and Del Rolan (1979) required 12 and 13-year-old girls who were intermediate level performers to perform a balance beam routine. This study was 6 weeks in duration but participants only spent 10 minutes on 1 day of each week practicing the routine. Additionally, for each 10 minute practice session, each participant only spent 1 or 2 minutes actually practicing on the balance beam. Participants from the experimental group viewed and analyzed their performances together with the aid of a provided checklist after all of them were done using the beam. Despite the fact that after

week one, the teacher did not help guide participants' viewing, the experimental group significantly improved more than the control group on 4 of the 8 items on which they were assessed which included precision of parts, elegance, execution, and amplitude (Selder & Del Rolan).

Oñate et al. (2005) employed a task designed to simulate grabbing a rebound in basketball. The goal for the landing phase of the task was for participants to land on two force plates (one foot on each one) as softly as they could. Results of the study showed that groups which were able to view their own performances fared better than the other groups in terms of lowering their peak vertical ground reaction forces for retention. They also had greater knee flexion maximum angles which were significantly greater than those of the control group during practice and retention. Lastly, they significantly outperformed the other groups during practice and retention in terms of knee angular displacement flexion angles. Interestingly, the groups which received video feedback achieved these things in spite of its short intervention (one day, 3 sets of 5 trials), and limited amount of video feedback (given between sets) (Oñate et al.). Although this was a simple task, this finding somewhat contradicts assertions made by Darden & Shimon (2000), and Rothstein and Arnold (1976), who seem to advocate that video feedback must be provided often for best results.

Del Rey (1971) conducted a study which employed a fencing lunge with beginners. The participants, 40 undergraduate women who were right-handed, were assigned to four different groups. These were an open condition with and without video feedback, and a closed condition with and without video feedback. Videotape feedback was shown to significantly improve form and reduce latency. Additionally, for the closed

skill, it was noted that participants had better form and accuracy scores. Because the participants within this study had no fencing experience, it provides an example where beginners improved through the use of video feedback.

Neufeld and Neufeld (1972) compared four groups in terms of their improvements on swimming performance. One group received video feedback, one viewed an expert model, one received a combination of the previous two treatments, and one did not receive a video intervention. Participants were emotionally disturbed children aged 3 to 6. The group that received video feedback significantly outperformed all other groups except the group which viewed the expert model. The study does not go into a vast amount of detail about how the skill was assessed, if and how feedback was guided, or the skill level of participants. However, considering the participants' ages, it is definitely possible that they could be classified as beginners, thereby providing additional evidence that beginners can, in fact, benefit from video feedback (Neufeld & Neufeld).

Comparison of Studies Which Support the Effectiveness of Video Feedback

Guidance of feedback. When looking at the previous studies, all of which showed video feedback to be effective, it is interesting to take note of various things. Neither Neufeld and Neufeld (1972), nor Guadagnoli et al. (2002) indicated whether or not learners were guided in some manner as they viewed their performances on video. All other studies indicated that guidance was provided to learners in one form or another as they viewed their taped performances. Perhaps the fact that viewing was guided in the majority of studies had a hand in their results.

Skill level of learners. Watkins (1963) used collegiate baseball players as participants. Experienced golfers participated in the study by Guadagnoli et al. (2002).

Intermediate level performers served as participants in the study by Selder and Del Rolan (1979). All three of these studies which examined the efficacy of video feedback in non-novices found it to be effective, thus supporting the notion that their learners were well suited to receive such feedback.

It is also noteworthy that participants for the study by Del Rey (1971) were beginners who had no fencing experience. Additionally, the age of participants in the study by Neufeld and Neufeld (1972) would make grounds for their possible lack of experience. Despite these things, the results of these two studies showed video feedback to be effective. This supports the notion that beginners can benefit as a result of receiving video feedback. It is also possible that the skills taught in these two studies were not extremely difficult, thus affecting relative skill complexity, which may have had a hand in the results. Oñate et al. (2005) employed a task, the exact replication of which was likely never before practiced by its participants. Perhaps relative skill complexity had a hand in its results as well, or perhaps its results were affected due to the likelihood that participants may have previously performed tasks similar to the one used for the study.

Frequency of video feedback employment. Of the six studies reviewed within this section, only the study by Oñate et al. (2005) definitely seemed to be lacking in the amount of times learners were provided with video feedback. This type of feedback was only provided two different times (between blocks one and two, and between blocks two and three). Additionally, this study also seemed to have a very short intervention period (three sets of five trials), but it is the only one of the above six studies which seems to fit into this category. Additionally, Neufeld and Neufeld (1972) may have only employed

video feedback a small number of times, but it is difficult to tell. The researchers did not indicate its duration, or how often video feedback was provided.

Type of improvements shown. It is additionally noteworthy that all of the above studies (as nearly as can be determined, gave knowledge of performance as feedback, and in doing so, half of them (most likely) specifically attempted to modify the movement pattern (Neufeld & Neufeld, 1972; Selder & Del Rolan, 1979; Watkins, 1963). However, these things can not be determined for certain in the case of Neufeld and Neufeld (1972), due to a lack of information provided in what was basically an abstract of their study. The other studies which attempted to modify both the movement pattern and the movement outcome (Del Rey, 1971; Guadagnoli, et al., 2002; Oñate et al., 2005), appeared to have done so successfully.

Non-Support for the Effectiveness of Video Feedback

Penman, et al. (1968) conducted a gymnastics study in which freshmen college students from physical education class sections were required to learn combinations of tumbling stunts. After the 12 week long intervention during which participants met twice per week for 35 minutes each time, their skills were rated by four judges. The experimental group (which utilized a videotape recorder) failed to perform significantly better than the control group which did not receive video feedback. The researchers gave few indications as to how video feedback was employed. This study provides an example in which video feedback was ineffective, even after a long intervention period (Penman et al.).

Another gymnastics-related study by James (1971) compared two groups that were equated based on performance and physical ability (by two assessors). One group

received video feedback and the other group did not as they learned "four basic drops and a seven-bounce routine" (p. 669) on a trampoline. Participants for the study were 18 beginner level boys (age 11-12), who participated in the 11 session (1 hour per session) intervention. Results showed that the group which received video feedback failed to perform significantly better than the other group. Drawbacks of this study as indicated by the author include absenteeism, which resulted in fewer participants, as well as a learning period which was of short duration. In addition, each participant practiced together with the other boys in his group during each 1 hour training session.

Emmen et al. (1985) conducted a study which compared five groups, each of which had no tennis experience. The two control groups received 45 and 30 minutes of traditional training respectively. In addition to 30 minutes of traditional training, the three experimental groups also received 15 minutes of video feedback, 15 minutes video modeling, and 15 minutes of a combination of the two treatments respectively. Participants who ranged in age from 18 to 60 years, were tested before, in the middle of, and after the intervention period of this five week (one day/week) study as they performed the Hewitt tennis test. This test required them to perform ten proper serves for which the ball should travel under a 2.12 meter high rope and land in the appropriate service court for a maximal score. As they performed this test, their form was also rated. Their results showed that all groups improved similarly across trials, thus showing video feedback and video modeling to be of no more avail than traditional training (Emmen et al.).

Van Wieringen et al. (1989) conducted a similar study which essentially compared video feedback and traditional feedback in teaching the tennis serve to (19 to

38 year old) intermediate players. After the 5 week (2 days/week, 40 min/day) study, participants were scored based on their accuracy and velocity, and rated based on their form. The video group spent 10 of the 40 minutes per lesson discussing videos of their serving performance. To equate groups in terms of practice time, the traditional training group spent 10 of the 40 minutes per lesson analyzing and discussing videos of highly advanced competitors who performed various tennis skills. Their results showed no significant difference between the video and traditional treatments (Van Wieringen et al.).

Sim & Stewart (1984) compared three groups of adults with developmental disabilities as they learned the standing broad jump. One group received video feedback, video modeling, and standardized verbal cues. A second group received standardized verbal cues with no video treatments. The control group for the study did not receive any feedback. Despite the fact that feedback was guided, pre-test and post-test data revealed no significant differences in terms of the dependent variables (distance jumped, and use of proper form). The researchers indicated that participants in the group that received video feedback may have been overwhelmed by the amount of information provided them. Additionally, a drawback of this study may have been its small sample size of only 16 participants (Sim & Stewart).

Kernodle et al. (2001) compared improvements in throwing distance, form, and mechanics for two groups of women (age 19-22) who threw a tennis ball with their non-dominant arm. One group received verbal prescriptive feedback, and the other received the same treatment plus video feedback. Both groups watched an expert video model at

various 10 trial intervals during this two week long (3 days/week) study which required participants to perform 400 trials in total.

Ten test trials took place at the beginning of day 1, and ten test trials took place at the end of each of the six intervention days, for a total of 70 no-feedback test trials. For the remaining 330 practice trials, a faded feedback schedule was used starting with 50% feedback being provided on days 1 and 2, and ending with 20% feedback on days 5 and 6. The only significant difference between groups was that the verbal group displayed better throwing form during the 5 day delayed retention test. These results occurred in spite of the long duration of the study, as well as the ample amount of video feedback provided to the video group (Kernodle et al.). An unusual factor in their methods was that it appears both groups received video modeling treatment, which could have contributed to the results.

Comparison of Studies which Do Not Support the Effectiveness of Video Feedback

Guidance of feedback. Most of these studies indicate that feedback was guided in one way or another. However, Penman et al. (1968) and James (1971) failed to give this indication. In addition, Kernodle et al. (2001) indicated that feedback was given to participants prior to viewing themselves on videotape. It is likely that this still served to guide them in viewing relevant information as they received video feedback. Neither the four studies which indicated that video feedback was guided nor the two which may or may not have provided guidance showed video feedback to be effective. While guidance of the learners' viewing is surely important, other factors must also play a role in determining the efficacy of video feedback.

Skill level of learners. Possibly one of the factors affecting the lack of success of video feedback for the studies in this section is the skill level of participants. Other than Van Wieringen et al. (1989), who employed intermediate level participants, the studies within this section used participants of lower skill levels. Perhaps this factor provides some reasoning for their results.

Sim & Stewart (1984) tested beginners. This should be considered as a possible reason why they did not benefit from video feedback. Another possibility is that they were simply overwhelmed by the wealth of information that was provided to them.

Relative skill complexity should also be discussed. Kernodle et al. (2001) employed a skill (overhand throw with non-dominant hand) which may have been too complex relative to the skill level of its novice participants. For this study, feedback (when given) was based on the first of 15 possible deviations from correct form within the throwing sequence (as displayed in the previous trial). If all of these 15 aspects were performed correctly, the words "Good throw" were given as feedback (Kernodle et al.). The amount of feedback given to participants may have been too voluminous for all of it to sink in. Perhaps this would not have been the case for participants of a higher skill level, as they would not have made as many errors within the sequence. As a result, feedback would be given to them on fewer aspects of the throw, minimizing the amount of information they would have to attend to. A similar result might also have been brought about if a less complex skill had been employed.

Emmen et al. (1985) may have also employed a skill that was too complex, relative to the skill level of learners. Perhaps learners would have showed significant improvements, at least in terms of form, if form ratings for the study had consisted of

fewer than 16 components. This goes back to the idea that if performers were more experienced, perhaps they would have previously mastered many of these components, thus requiring them to attend to a smaller amount of information during the intervention period of the study. As with the study by Kernodle et al. (2001), the possibility that different results would have ensued if a simpler skill had been employed also exists.

For the remaining two studies (James, 1971; Penman et al., 1968) learners were definitely beginners. This could have had a hand in the results. As far as relative skill complexity is concerned, not enough information about skill and feedback complexity is given to provide insights as to how it affected the results of these studies.

Frequency of Video Feedback Employment. Although its learning period was 11 hours long (two, one-hour sessions per week) James (1971) indicated that its intervention was of short duration. Perhaps this is because each learner practiced with the other boys in his group, possibly requiring them to share valuable practice time. Additionally, Penman et al. (1968) and Sim & Stewart (1984) fail to adequately indicate the duration of their studies. For these studies, lack of an adequate number of video replays could have played a role in the lack of success on the part of their video feedback groups (although not enough information is provided to determine this). This was probably not an issue in the remaining studies within this section as they seem to have been of more than adequate duration with plenty of video replays.

Type of improvements shown. Two of the studies within this section attempted to modify movement patterns (James, 1971; Penman et al., 1968). The remaining four studies looked at movement patterns and movement outcomes (Emmen et al., 1985;

Kernodle et al., 2001; Sim & Stewart, 1984; Van Wieringen et al., 1989). Regardless of what they sought to modify, they all showed video feedback to be ineffective.

Video Feedback Studies with Mixed Results

Bunker, Shearer, and Hall (1976) asked young participants who had never been formally instructed in swimming to practice the flutter kick. Eighteen participants were younger (age 4.5 to 6.4 years) and eighteen were older (ages 6.5 to 8.5 years). Half of the participants from each age group received feedback via video, and the other half from each age group received feedback verbally (resulting in 4 groups of 9 participants). When group improvements were determined, it was shown that the older video group significantly outperformed the older verbal group. The younger video group did not outperform the younger verbal group to a significant degree. They concluded that the efficacy of video feedback is related to the age of participants (Bunker, et al.).

Boyce et al. (1996) conducted a two part study which compared teacher feedback, video feedback with cueing, and peer feedback. The overhead pass in basketball was performed by third graders for part one. There were 51 participants who made up the three treatment groups (represented by 3 different classes). For the third graders, teacher feedback was the most effective treatment, followed by video feedback with cueing, which was followed by peer feedback. The forehand tennis strike (performed by fifth graders) was the skill to be learned for part two. The 53 fifth graders (three different classes) made up the three groups (same as part 1). The video feedback group improved more than the other two groups. The authors indicated that the fifth graders were possibly able to better utilize the video feedback as compared to the third graders. An

additional possibility is that they were less dependent on feedback given by their teacher (Boyce et al.).

Participants in the study by Burkhard, Patterson, and Rapue (1967) spent 9 weeks (2 classes/week, 1.5 hours/class), learning two elementary defensive maneuvers consisting of blocks, kicks, and strikes. Near the beginning of class on each Tuesday, while the control group practiced normally, the experimental group viewed their performances on video. Together, the group viewed the film of each pair of students as it was played. Video of each pair was played twice in slow motion on average, during which time, errors were pointed out, and corrective feedback was given. After the viewings, the two groups rejoined and class continued. After 5 weeks, the video group showed significantly superior performance. At the end of week 8, no significant group differences existed. Perhaps this was due to the fact that a more complex maneuver was taught from weeks 6-9, then the one which was taught from weeks 1-5 (Burkhard et al.).

Rikli & Smith (1980) compared three video feedback groups and a control group (that did not receive video feedback) as they practiced proper tennis serving form. One video feedback group received the video treatment on day one of the study, another received the video treatment on day three, and another received video on days one and three. Participants from the video groups performed significantly better than the control group on only one aspect of form, the first phase of the arm pattern. The researchers indicated that this could have been the case because participants may not have been able to see as much of this part of the serve as other parts. The intermediate level participants from the video groups also bested the control group (by a significant amount) in terms of

footwork, indicating that video feedback may be more effective for more highly skilled participants (Rikli & Smith).

Comparison of Studies with Mixed Results

Guidance of feedback. A commonality between the studies in this section is that when the video treatments were employed, feedback was guided. Mixed results occurred in spite of this. Consequently, it seems that other factors played a role in determining various results.

Skill level of learners. Rikli and Smith (1980) provides support to the notion that participants of a higher skill level may reap more benefits when provided with video feedback. It should be noted that intermediate level performers who received video feedback performed significantly better than the control group in terms of footwork while advanced beginners who received video feedback did not. In the case of this study, it appears that the skill level of learners may have affected the results.

Boyce et al. (1996) may also support the idea that learners of a higher skill level are more likely to benefit from video feedback as opposed to less skilled learners. This possibility is indicated by the fact that the study found video feedback to benefit fifth graders (who were learning the forearm strike in tennis) more than other types of feedback, while the same was not true for third graders (who were learning the overhead pass in basketball). While these results may have been related to skill level, it is also possible that age played a role.

The skill level of the learners could have also affected the results of the study by Bunker et al. (1976) as video feedback prevailed over verbal feedback in older children

who were learning the flutter kick (aged 6.5 to 8.5 years), but not in younger ones (aged 4.5 to 6.4 years). On the other hand, this could have resulted due to age related factors.

Burkhard et al. (1967) indicated that the video feedback group bested the control group when a simpler maneuver was taught during the first five weeks. However, this was not the case when a more complex maneuver was taught (during the last 3 weeks). In the case of this particular study, learners could have only improved from the time they started learning the simpler maneuver to the time they started learning the more complex maneuver. Nonetheless, video feedback was shown to be the most effective treatment in the learning of the simpler maneuver. A more complex factor than skill level of the performers had to have taken an effect here. Perhaps relative skill complexity was a determining factor in this study.

Frequency of video feedback employment. A point of slightly greater variability between the studies might be the amounts of practice, as well as the amount of video feedback they employed. However, based on information given, it is somewhat difficult to tell for a few of them.

Boyce et al. (1996) and Bunker et al. (1976) employed three, thirty-minute days, and four fifteen minute instructional sessions respectively. Neither study is specific as to the amount of video feedback each participant received individually, but both seem to indicate that the learners of various groups in each of the two studies practiced with the other members of their groups. This could mean that they had to share the video camera, as well as the instructor, possibly minimizing the amount of video feedback received.

Rikli and Smith (1980) used five days, and instruction contained a number of hours equal to or greater than a typical tennis activity class. The best conclusion that can

be drawn from this information is that the intervention of the study was at least 3 hours long (as typical college classes tend to meet for three hours per week). Videotape feedback was given on at least 9 serves for two of the video groups, and possibly (although not specifically indicated) at least 18 serves for another video group.

These three studies were at best moderate in duration, and amount of video feedback provided. However, this was not the case for Burkhard et al. (1967). Their study had a lengthy duration of 9 weeks (2 days/week, 1.5 hours/day). Additionally, video feedback was provided often (near the beginning of practice on nine different days).

Type of improvements shown. The studies all sought to modify the same thing, movement pattern. As previously indicated, they met with success in terms of certain aspects and failure in terms of other aspects (Boyce et al., 1996; Bunker et al., 1976; Burkhard et al., 1967; Rikli & Smith, 1980).

Important Variables in Administration of Video Feedback

In order for video feedback to be employed effectively, three main things should take place. Video feedback should be guided, learners should be of an appropriate skill level, and video feedback should be administered at an appropriate frequency.

Guidance of Feedback. It is definitely important to properly guide learners viewing when they watch their performances on tape (Boyce et al., 1996; Darden & Shimon, 2000; Del Rey, 1971; Rothstein & Arnold, 1976). Of the studies reviewed in this paper, none of them indicated that video feedback was not guided during their interventions. Four of them did not indicate one way or the other (Guadagnoli et al.,

2002; James, 1971; Neufeld & Neufeld, 1972; Penman et al., 1968). The rest of them indicated that it was guided.

Skill level of learners. Another notion often put forth by researchers is that the effectiveness of video feedback is affected by the skill level of the learners receiving it. As mentioned previously, many believe that beginners receive fewer positive effects from video feedback, than more experienced learners (Darden & Shimon, 2000; Kernodle et al., 2001; Rikli & Smith, 1980; Selder & Del Rolan, 1979). Conversely, Del Rey (1971) as well as Neufeld and Neufeld (1972) provide prime examples of studies where beginner level learners benefited from video feedback.

A seemingly overlooked aspect in accounting for the efficacy or inefficacy of video feedback is relative skill complexity. Kernodle et al. (2001) attempted to teach beginners a fairly complex skill (overhead throw broken down into 15 components). Emmen et al. (1985) rated novice participants on 16 components of the serve. Video feedback failed to be the most effective form of feedback in both of these studies. While it is likely that the skill level of participants affected these results, it could also be that the complexity of the skills employed also played a role. Perhaps if a skill with fewer components had been taught in the case of either study, learners might have been able to better harness the benefits of video feedback.

Results from Burkhard et al. (1967) suggest that relative skill complexity should not be overlooked. They found video feedback to be more successful in teaching a simple karate maneuver as opposed to a more complex one. In this case the complexity of the skill, rather than the skill level of the learners may have had a stronger affect on the

results. Consequently, this study makes a case that relative skill complexity may be an important factor in determining the efficacy of video feedback.

Frequency of feedback employment. Duration of the intervention as well as the amount of times video feedback is employed both play a role in determining its efficacy. As indicated by Darden and Shimon, (2000) and Rothstein and Arnold (1976), if video feedback is sparsely employed, it will not have the best chance to affect learners positively. Results from a number of studies, however, indicate that there are exceptions to this rule.

Six of the studies reviewed showed video feedback to be effective. Of these six, Oñate et al. (2005) was the only one to definitely indicate a short duration and a sparse amount of video feedback employment. Neufeld and Neufeld (1972) did not seem to provide this information. The other four studies (Del Rey, 1971; Guadagnoli et al., 2002; Selder & Del Rolan, 1979; Watkins, 1963) seemed to have had interventions of adequate length. They also seemed to have employed adequate amounts of video feedback.

Six other studies showed video feedback to be ineffective. Of these six, James (1971) indicates that the intervention in her study was short. Two of them (Penman et al., 1968; Sim & Stewart, 1984), do not provide this information. The remaining three (Emmen et al., 1985; Kernodle et al., 2001; Van Wieringen et al., 1989) were seemingly adequate in length, and provided fair amounts of video feedback, but still did not show video feedback to be effective.

Four studies found mixed results in determining the efficacy of video feedback. As previously indicated, three of these (Boyce et al., 1996; Bunker et al., 1976; Rikli & Smith, 1980) were at best moderate both in duration and in amount of video feedback

provided. The fourth, (Burkhard et al., 1967) gave learners a generous amount of time and video feedback in order to help them learn two elementary defensive (karate) maneuvers.

In comparing the six studies that showed video feedback to be effective and the six that showed it to be ineffective, results are somewhat similar. Both groups of six indicated that comparable amounts of studies provided adequate amounts of video feedback. Additionally, each set of six studies is made up of similar numbers of studies with interventions of seemingly adequate length. Of the studies which provided mixed results, one had ample length, and applied a good deal of video feedback. The other three may or may not have. While it must be a factor, it seems difficult to notice any strong correlations between the frequency of video feedback employment, and its efficacy.

Results of Changes in Movement Patterns

In motor skills, improvements in form have been shown to bring about improvements in results. However, such changes to the movement pattern often first cause detriments in terms of the results of the movement pattern before improvements ensue (Guadagnoli et al., 2002). It may be for this reason that most researchers focus improvements in form when evaluating the efficacy of video feedback as did all video feedback studies reviewed in this paper. A significantly smaller amount (7 of the 16 studies in this paper) looked at improvements in results in addition to improvements in form (Del Rey, 1971; Emmen et al., 1985; Guadagnoli et al., 2002; Kernodle et al., 2001; Oñate et al., 2005; Sim & Stewart, 1984; Van Wieringen et al., 1989). It seems that in studies of short duration, changes are more likely to occur in the variable that feedback is directly modifying as opposed to the results that this variable is intended to improve.

Summary of Video Feedback

Many factors affecting the efficacy of video feedback remain a conundrum. It appears that in order for video feedback to be effective, it should be employed under certain conditions. Firstly, when video feedback is administered, learners should be guided so they focus on relevant aspects of the replay. Secondly, the skill level of learners appears to play a role, and relative skill complexity should also be considered as a possible factor. Thirdly, video feedback must be provided often enough if it is to benefit learners.

Self-Control and the Choice Between Video and Verbal Feedback

Augmented feedback is given in supplement to what learners glean automatically (Schmidt & Wrisberg, 2008). Because video feedback fits under the category of augmented feedback, it seems plausible that when it is employed successfully, it provides learners with information that they did not get from other forms of feedback (Rikli & Smith, 1980). This would indicate that different forms of feedback (i.e. verbal and video) provide learners with different pieces of information. Evidence supports that allowing learners to control various aspects of their learning environment is beneficial because it allows them to get information they need when they need it (Chiviacowsky & Wulf, 2002, 2005). This seems to be showcased by the general efficacy of self-control (Chen et al., 2002; Chiviacowsky & Wulf, 2002, 2005; Chiviacowsky, et al., 2008; Janelle et al., 1995; Janelle et al., 1997; Titzer et al., 1993; Wulf, & Toole, 1999; Wulf, et al., 2001; Wulf et al., 2005). It may be then, that when given the choice, learners will choose the type of feedback (video or verbal) that provides them with the most pertinent information

on each given feedback trial. However, this is not certain as it appears that this aspect of self-control has not yet been investigated.

The Squat

The squat is an important part of the conditioning programs of a number of different types of athletes (Escamilla et al., 2001; Escamilla & Krzyzewski, 2001; Walsh et al., 2007; Wretenberg et al, 1996). Strength gains made during training depend greatly on the particular exercises performed, and how much they resemble the activity that the training is attempting to improve. The closer the training resembles the activity, the more effective it will be in terms of fostering improvements (Brooks, Fahey, & Baldwin, 2005). Perhaps the fact that the squat resembles many movements within sport (Escamilla et al., 2001; Escamilla & Krzyzewski, 2001; Lander et al., 1986) is the reason why it is so often employed in athletic conditioning.

Safety Implications for Squat Performance

While the squat has been highly used in the conditioning of athletes, concerns have often been voiced as to its potential to cause injury (Lander et al., 1986). However, safety can be maximized through the use of correct form (Chandler & Stone, 1991; Escamilla & Krzyzewski, 2001; McLaughlin et al., 1977). Consequently, proper form should be taught to those who are learning the squat, so they can reap the benefits of performing this exercise while minimizing the risk of injury.

A review by Escamilla & Krzyzewski (2001) drew conclusions based on previous research which examined the biomechanics of the knee during squat performance. They concluded that shear forces on the posterior portion of the knee were no more than moderate, and that between 0 and 60˚ of flexion, shear forces on the anterior portion of

the knee were low. For this reason they asserted that if used appropriately, with appropriately light loads, and appropriate ranges of motion (0 to 50˚), the squat could possibly be used in rehabilitation of ACL and PCL injuries.

The authors asserted that athletes should train using the parallel squat (thighs parallel to the floor) provided that their knees are healthy, and that deeper (below parallel) variations of the squat may be unsafe. They also put forth the notion that the squat is not only safe for the knees, but it also has the potential to enhance knee stability if it is performed in the correct manner. Lastly, they mentioned that the parallel squat rather than variations with a smaller range of motion should be performed by athletes due to its greater stimulation of muscle activity (Escamilla & Krzyzewski).

Walsh et al. (2007) analyzed movements of the lumbar spine in 28 male, and 20 female athletes as they performed squats. Each participant performed squats at 40, 60, and 80% of their 1 rep max, both with and without the use of a lifting belt. Among the findings were that participants exhibited only small amounts of lateral flexion, and axial rotation. Consequently, the focus of the results turned toward flexion and extension of the lumbar spine. An important finding of this study was that regardless of gender or the use of a weight lifting belt, squatting of heavier weights resulted in greater amounts of spinal hyperextension. Participants had to hyperextend their lumbar spines in order to keep their heels from breaking ground contact, as well as to maintain stability. While the authors viewed increased hyperextension as a result of heavier loads as possible threat of injury, they mainly raised concern for the safety of individuals who were not at full skeletal maturity (Walsh et al.). At any rate this study provides support for the notion that hyperextension of the lumbar spine may be inevitable if the lifter is to maintain a flat

footed posture without excessive reliance on the back musculature to squat heavy weights. Resultantly, a lifter who exhibits a slight amount of lumbar lordosis may still be considered to have a straight back. The critical aspect in terms of proper form is that the back does not flex during the movement.

McGill (2004) reviewed various pieces of information as to the way the lower back functions, as well as mechanisms which result in its injury. One conclusion is that in a number of areas where back injury may be of concern, the only way to aid in its prevention is to use appropriate movement patterns. Biomechanical analyses have resulted in recommendations that involve disallowing the load being lifted to act on a moment arm that is overly lengthy (McGill). Although Walsh et al. (2007) raises concerns due to the extension of the lumbar spine that ensues during the squat as a result of lifting heavy loads, this is preferable to an extensive amount of forward lean. It seems rather intuitive that excessive forward lean during squat performance would result in greater shear forces acting on the spine as a result of an increased moment arm length.

To summarize, if performed properly, the squat is not detrimental to the knee, and it may even provide benefits (Escamilla & Krzyzewski, 2001). Some concerns raised are due to lumbar extension resulting from lifting heavier weights (Walsh et al., 2007), but it appears that this is preferable to excessive forward lean (McGill, 2004). Regardless of questions posed as to the safety of the squat, it plays an integral role in the conditioning of athletes (Escamilla et al., 2001; Escamilla & Krzyzewski, 2001; Walsh et al., 2007; Wretenberg et al., 1996). Consequently, it is important to make it as safe and beneficial as possible through the use of proper squatting form.

Form for the Squat

As previously mentioned, squatting with proper form is very important (Chandler & Stone, 1991; Escamilla & Krzyzewski, 2001; McLaughlin et al., 1977). Consequently, the present section outlines twelve aspects of proper form for the squat as broken down by the author of this paper. Most of the sources used in the outlining of this information were published by the National Strength and Conditioning Association (NSCA) (Baechle & Earle, 2004; Barnes & Cinea, 2007; Earle & Baechle, 2008). Others affirm the guidelines put forth by the NSCA (Chandler & Stone; Graham, 2008).

Foot position. The feet should be parallel (Baechle & Earle, 2004), and shoulder width apart or wider (Baechle & Earle, 2004; Barnes & Cinea, 2007; Earle & Baechle, 2008) with the toes pointing outward slightly (Baechle & Earle, 2004; Barnes & Cinea, 2007). The bottoms of the feet should remain in contact with the floor during the course of the entire movement (Chandler & Stone, 1991; Graham, 2008), with special attention given to ensure that the heels remain on the floor (Baechle & Earle, 2004; Earle & Baechle, 2008).

Grip. The bar should be grasped with a pronated grip, which is slightly wider than the shoulders (Baechle & Earle, 2004; Barnes & Cinea, 2007; Earle & Baechle, 2008; Graham, 2008).

Elbow position. The elbows should be kept up (Baechle & Earle, 2004; Earle & Baechle, 2008; Graham, 2008) and back (Baechle & Earle, 2004) throughout the movement in order to ensure that the bar has an acceptable place to rest (Earle & Baechle, 2008; Graham, 2008).

Bar position. The bar should rest above the posterior deltoids (Baechle & Earle,

2004; Earle & Baechle, 2008; Graham, 2008) at the base of the neck (Earle & Baechle, 2008).

Chest position. The chest should be out (Baechle & Earle, 2004; Earle & Baechle, 2008) and up (Baechle & Earle, 2004; Barnes & Cinea, 2007; Earle & Baechle, 2008) during the movement.

Head position. The head should be erect (Graham, 2008) with a slight upward tilt (Baechle & Earle, 2004; Earle & Baechle, 2008).

Hip and knee flexion and extension. During the down phase of the squat, the angle formed by the torso and the floor should remain constant. Additionally, to ensure that this angle stays constant during the up phase, the hips and knees should be extended at the same rate (Baechle & Earle, 2004; Earle & Baechle, 2008). During the up phase, special care should be taken in order to ensure that the hips do not rise faster than the bar (Barnes & Cinea, 2007).

Back position. The back should remain flat (neutral) during the performance of the squat (Baechle & Earle, 2004; Barnes & Cinea, 2007; Earle & Baechle, 2008; Graham, 2008). It should not flex (round) during any part of the movement (Graham, 2008).

Position of knees. The knees should remain over the feet throughout the movement (Baechle & Earle, 2004; Earle & Baechle, 2008), and should not move past the toes (Barnes & Cinea, 2007). Additionally, the knees shouldn't move towards, or away from each other during the course of the movement (Baechle & Earle, 2004).

Controlled motion. The movement pattern should remain consistent from one repetition to the next (Barnes & Cinea, 2007; Chandler & Stone, 1991). The movement should also be smooth, without any bouncing (Chandler & Stone, 1991; Graham, 2008) or twisting (Chandler & Stone, 1991) type movements. The downward movement should be slow (Baechle & Earle, 2004; Earle & Baechle, 2008) and controlled, taking approximately 2 seconds to bring the thighs to parallel (Chandler & Stone, 1991). The upward phase doesn't have to be as slow as the downward phase, but technique should remain correct, especially at faster speeds (Chandler & Stone, 1991).

Breathing. Before the down phase, the performer should take a breath. The breath should be exhaled starting at the midpoint of the up phase (Chandler & Stone, 1991; Graham, 2008).

End of down phase. The down phase ends when the thighs are parallel with the ground, the trunk rounds, or the heels break contact with the ground (Baechle & Earle, 2004; Earle & Baechle, 2008; Graham, 2008).

The following list of components comprising optimal form for the squat was composed using the above information.

1. The feet should be shoulder width apart and parallel to each other. The toes should be pointed slightly outward. The entire bottom of foot should be in contact with floor for entire movement.
2. The grip should be pronated with the hands closed around the bar and slightly wider than the shoulders.
3. The elbows should be up and back.
4. The bar should be at the base of the neck, resting on posterior deltoids.

5. The chest should be up and out throughout the course of the movement.
6. The head should be tilted slightly upward.
7. The knees and hips should flex/extend at the same rate.
8. The back should stay flat (without rounding).
9. The knees shouldn't move past the toes, medial to, or lateral to the feet.
10. The descent should be slow and controlled. The ascent should also be controlled. No bouncing or jerky movements should be present. (The ascent may be faster than the descent.)
11. The performer's breath should be held prior to movement. Exhalation should begin at midpoint of up phase.
12. The down phase should end with thighs parallel to the ground.

Summary of the Literature Review

It is likely that different forms of augmented feedback, such as video feedback and verbal feedback, provide learners with different pieces of information. The effectiveness of an environment which allows learners to control certain aspects of learning has been shown (Chen et al., 2002; Chiviacowsky & Wulf, 2002; Chiviacowsky & Wulf, 2005; Chiviacowsky, et al., 2008; Janelle et al., 1995; Janelle et al., 1997; Titzer et al., 1993; Wulf, & Toole, 1999; Wulf, et al., 2001; Wulf et al., 2005). Since the squat is a skill which requires proper form (for safety and effectiveness), this exercise provides an ideal testing ground for examining self-control effects on skill acquisition.

When the above information is taken into consideration, it seems that self-control might prove valuable for those who are learning proper squatting form. No study has been found that previously investigated the efficacy of allowing learners to control the

type of feedback they received in the learning of a motor skill. Perhaps allowing learners to choose between verbal and video feedback as they learn the squat will yield positive results.

Chapter 3

Methods

The purpose of this study was to compare the efficacy a learning environment which allowed learners to determine the type of feedback they received, and one which did not. It was hypothesized that participants who were permitted to choose the type of feedback they received would show greater improvements than participants who were not given the choice as they learned the proper form for the back squat (to parallel) using the high-bar position.

This chapter outlines the methods for this study. The following aspects of the methods are discussed: a) participants, groups, and random assignment, b) components of and the starting position for the squat, c) description of the apparatus, task, and equipment, and position/calibration of equipment, d) provision of feedback and equation of the intertrial interval between groups, e) instructions, tests, practice, and procedures.

Participants

College-aged participants who indicated that they had five or fewer days experience performing the squat, and who had no self-disclosed physical limitations such as back or knee injuries were recruited as volunteers. Following IRB approval (see Appendix A) participants were recruited from a number of undergraduate classes within various departments at SUNY Cortland. When recruiting participants, the researcher presented the information in the form titled “Explanation of the Study” (see Appendix B) to various classes at times previously scheduled by class instructors.

An information form (see Appendix C), which provided information on what to wear, as well as directions to the testing area, and a participant recruitment form, (see

Appendix D) which gathered contact information as well as other information, were provided for each prospective participant. Participants who fit the necessary criteria and who were available during open time frames were re-contacted and asked if they would like to participate. It was important that they were able to commit to the same one-hour time slot on the same day of each week for three weeks in a row. However, they were free to withdraw at any time. The researcher indicated that forms would be kept confidential, and they would be destroyed when they were no longer needed.

Groups

There were two groups of participants. The self-control group was permitted to choose the type of feedback (verbal or video) they received following each feedback trial. Each participant within the yoked group was matched with a participant from the self-control group in terms of the type of feedback received following each feedback trial. (For example if participant number one for the self-control group chose video feedback on trial 2 of the intervention, than participant number one for the yoked group received video feedback on trial 2 of the intervention and so on.)

A form called the feedback choice sheet (see Appendix E) was used to record the last four digits of the student ID number of a participant from the self-control group, as well as the assigned time slot. This was done when he/she arrived on the first day. Additionally, his/her feedback choice (video or verbal) was recorded for each feedback trial. When the self-control participant's counterpart (from the yoked group) arrived, the last four digits of his/her student ID number, as well as the time slot he/she signed up for, was added to the feedback choice sheet. Following each feedback trial, he/she was provided with the same feedback as was received by the self-control participant.

Additional feedback procedures for the two groups within this study are described in more detail later in this chapter.

Random Assignment

For obvious reasons, the first male and the first female to arrive for the study were automatically assigned to the self-control group. Consequently, the last male and the last female to arrive for the study were automatically assigned to the yoked group. All other participants were randomly assigned to groups.

Squat Components List and Starting Position List

The following lists were based on the list of the components of the proper form for the squat (which is located near the end of chapter two). The first list was used to provide feedback during instruction. The second list contains various components of the starting position for the squat. The order and wording of some of the components of the following lists have been modified (as compared to the list in Chapter two). Some components have been separated in order to provide for ease of use on the part of the researcher as well as the participants.

Squat Components List.

1. The head is pointed straight ahead or tilted slightly up throughout the movement.
2. The elbows are up and back.
3. The bar is at base of the neck, resting on the back portions of the shoulders.
4. The back stays flat (does not round forward).
5. The chest is up and is puffed out throughout the course of the movement.
6. The bottoms of the feet are in contact with the floor for the entire movement.
7. The knees don’t move past the toes.

8. The knees and hips bend/straighten at the same rate.
9. The down phase and up phase are performed in a controlled manner with no bouncing or jerky movements.
10. The down phase ends with the thighs parallel to the ground.

Starting Position List.

1. The feet are shoulder width apart or wider.
2. The toes are pointed slightly outward.
3. The grip is slightly wider than the shoulders.
4. The feet are not staggered.
5. A forward grip is used, with the hands closed around the bar.
6. The knees are over the feet. (They are not too close together or too far apart.)

Starting Position

Prior to the start of each trial, the participant was asked to assume the starting position for the squat. He/she was asked to stand directly over a taped line (taped line one) which was positioned 3.42 meters from the lens a video camera with one foot on either side of the line and each foot equidistant from it. The midline of the participant's body was directly over the taped line. The participant placed his/her toes less than .5 centimeter away from (but not touching) taped line two, which was at the end of taped line one (see Figure 1). While doing this, the participant adhered to the components of the starting position list (above). The left side of the participant was facing the lens of the video camera. Additionally, because the participant was performing the back squat, the bar was positioned behind the participant's head. Lastly, a 1.52m long barbell which weighed 5.09kg was held in the high bar position, which required the participant to rest it

at the base of his/her neck, on top of the posterior deltoids (refer to top picture in Appendix H).

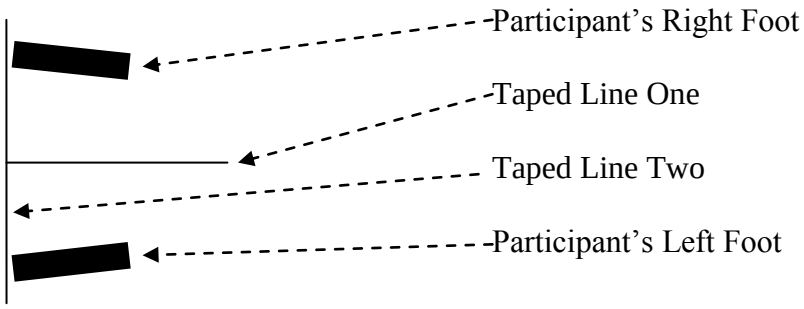

Figure 1. Diagram of taped lines and participant's feet for starting position (overhead view).

Apparatus and Task

The study was conducted in a squash court which was approximately 9.7 meters long and 5.64 meters wide. On each trial, the participant was told to assume the starting position. Once the participant adhered to all aspects of the starting position, the experimenter began video recording the participant (from a sagittal plane view) after which, he said the words "begin when you are ready". At this point, the participant performed one repetition of the squat. At the completion of the repetition, the experimenter stopped video recording the participant.

Position of Video Capture and Viewing Equipment

The video camera was positioned near the back wall of the squash court (see Figure 2). The camera's lens was 3.42 meters from taped line one. Its lens was pointing towards the front wall of the court so that it could record the participant's performance from a sagittal plane view. Both the camera and the taped line (over which the

participant was standing) were approximately centered between the left and right walls of the squash court, and the taped line was approximately 3.30 meters from the front wall of the squash court. The base of the camera rested on top of a level tripod and the height of the optical axis of its lens was 68.8 cm above the floor. A laptop computer which was connected to the camera, was positioned at a table to the right of the camera. Additionally, a projector, which was connected to the computer, was positioned on a chair, and focused on the left wall.

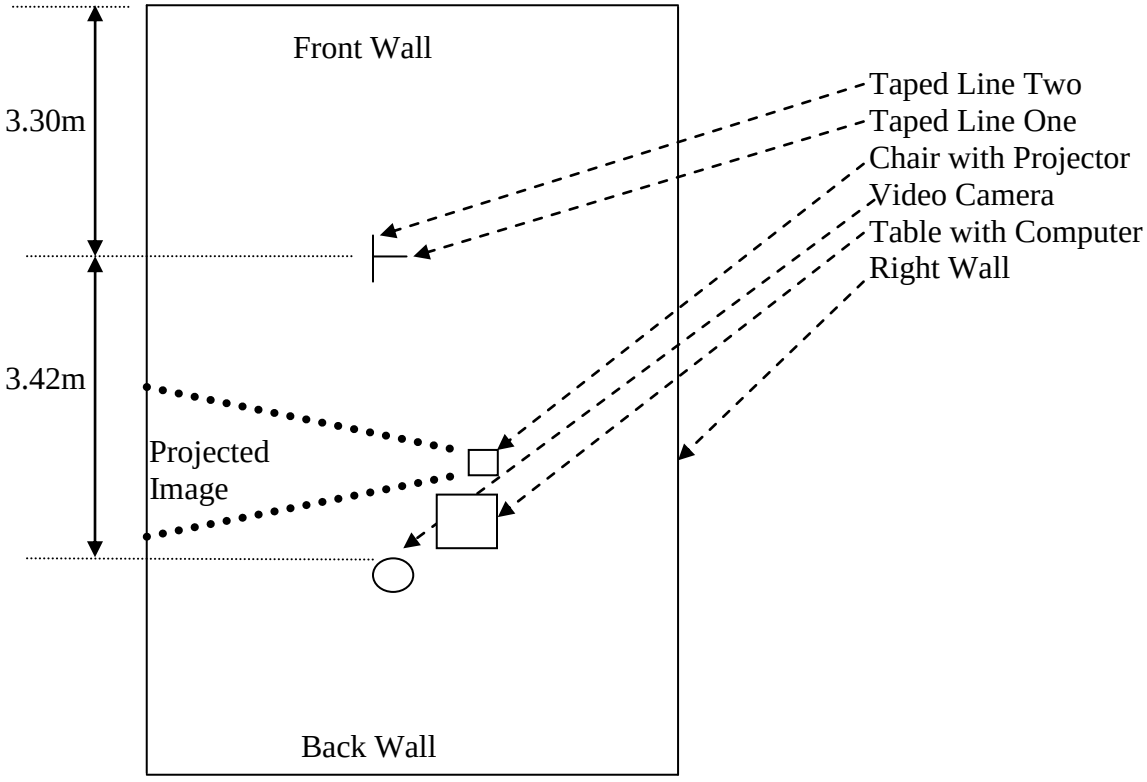

Figure 2. Diagram of squash court with location of equipment, walls, and taped lines.

Description of Equipment

The camera used for data collection was a JVC Mini DV video camera (model GR-DF550u) which captured data at a rate of 30 frames per second (60 fields per second). The camera's shutter speed was set to 1/60 second. The camera was connected to a Dell (Inspiron 6400) laptop via a firewire cable. Windows Movie Maker was used to capture, save, and replay the data (videos). Data was stored on a 500GB Western Digital portable hard drive, and a 120GB Western Digital portable hard drive. After the data was no longer needed by the researcher, it was deleted. The laptop computer was used for viewings of video replays by the experimenter. Additionally, the projector was a typical classroom projector obtained from classroom media services at SUNY Cortland. The tripod used was a Bogen professional tripod (model 7021). Lastly, a 1.52 meter long barbell weighing 5.09 kg was used.

Figure 3. Pictures of various pieces of equipment used in the study.

Camera Calibration

After the camera was positioned on the tripod, a plumb-bob was used to center its lens over a point on the floor that was 3.42 meters from the middle of taped line 1. To ensure that this was the case, a plumb-bob was strung from a specific point on the

camera's lens. The camera was positioned so that the plumb-bob hung directly over the previously described point on the floor.

The camera lens was zoomed all the way out to a focal length of 3.0mm. The computer, which was connected to the camera, was set up so that the full screen of the computer displayed the same view as the viewfinder of the camera (only larger). The pan and the tilt of the tripod were then adjusted so that various tape markings on the walls of the squash court were barely inside the view displayed on the sides of the computer screen, and a tape mark on the floor of the squash court was barely inside the view displayed on the bottom of the computer screen. After adjustments were made, the camera was fully stabilized, and the computer was taken out of full screen mode. The same camera calibration process was followed at the beginning of each day when the camera was set up for data collection.

Provision of Feedback on Squat Components

Following each feedback trial, members of the two experimental groups received feedback based on one of the first ten components from the Squat Components List. The feedback list (see Appendix F) was used to provide this feedback. (Components 1-10 of the feedback list coincided with components 1-10 of the squat components list.) The component chosen on a given feedback trial was determined in the following manner. Because they were likely easiest to master, errors in components 1-3 were generally corrected before all other components. If the participant failed to adhere to one or more of these 3 components, feedback was given based on the one that would help the participant to display the best form by the end of the study (based on the researcher's perceptions).

If the first three components were performed correctly, and one or more of the final seven components (components 4-10) were performed incorrectly, feedback was given based on the component that would help the participant to display the best form by the end of the study (based on the researcher's perceptions). If all ten components were performed correctly, the researcher would say "You performed all ten components correctly" and no feedback would be administered that trial.

Provision of Video versus Verbal Feedback

Feedback was given to each participant following every second trial on day one and trials 3, 6, and 9 of each block of 10 trials on day two. After the participant had completed the task and placed the bar on the floor, the researcher would provide either verbal feedback or video feedback. The researcher would either ask (for the self-control group) or tell (for the yoked group) the participant which type of feedback would be given based on the previous trial.

When video feedback was provided, the participant stood near the taped lines. An enlarged version of the feedback list was positioned on the left wall of the squash court in front of the area where the squat was performed. The researcher told the participant which aspect of the skill to focus on by saying the words "Focus on component" followed by the number of the component, and a key word associated with the component. Next, the researcher said the word "read", followed by the number (or number and letter if more appropriate) associated with the statement that most specifically and accurately pointed out the aspect of the component that was in need of correction. (For example, there were three statements for component 6. Statement 6 was vague, and was able to be used at any time without error. Statements 6a, and 6b were more specific making them

better for some instances but inappropriate for others.) After reading the appropriate statement, the participant watched a video replay of the previous trial one time (as it was projected on the left wall of the squash court) while adhering to the statement that he/she read. Both the feedback list and the projection of the video were large enough for the participant to easily view from his/her position near the taped lines.

On trials when verbal feedback was provided, the experimenter viewed the video replay of the participant one time on the computer monitor. (It was not projected onto the wall.) He then read the appropriate statement from the feedback list, preceded by its number (and letter if more appropriate) on the list, and its associated keyword.

On some feedback trials, regardless of which type of feedback was provided, the researcher was not sure to which component to read or direct the participant. When this was the case, the researcher viewed the replay of the participant's performance one time following a video feedback trial, or a second time following a verbal feedback trial before providing the appropriate feedback as described in the previous paragraphs. If after an extra viewing, the researcher was still unsure of which component to read or direct the participant to, he would view the replay as many additional times as was needed. This was not necessary most of the time.

Additional Postings on Left Wall

The squat components list (see Appendix G) as well as three pictures of the video model (see Appendix H), which showcased the components on the list were provided for participants. One picture was of the video model in the up position. Another picture was of the video model in the down position. A third picture was of the video model half-way between the two positions. Additionally the corrective feedback list (see appendix I) was

provided for participants. All of these things were posted on the left wall of the squash court, to the right of the feedback list, and participants were permitted to refer to them at any point during the course of the study.

Equation of Intertrial Interval

The intertrial interval was similar on trials where video feedback was provided, and trials where verbal feedback was provided. Following video feedback trials, the participant was directed to focus on an appropriate component, and read a particular statement after which he/she watched a video replay. Following verbal feedback trials, the instructor watched the replay, after which he read the appropriate statement to the participant. In each case, essentially the same things happened, and they took essentially the same amount of time. However, it is possible that following certain trials, video feedback was slightly more time consuming despite the fact that every attempt was made by the researcher not to allow this to happen.

Instructions for Groups

Instructions (see appendix J) were read to participants prior to the first blocks of days 1, and 2. Participants in the self-control group were read one set of instructions on day one and another set of instructions on day two. Participants in the yoked group were read a slightly different set of instructions on day one, and another set of instructions on day two.

Initial, Mid, Post, and Retention Tests

For the initial, mid, post, and retention tests, five no-KP trials were performed. Prior to each test, a pre-testing statement (see appendix K) was read to the participant. At the start of each trial, the participant assumed the starting position for the squat. The

researcher checked to ensure that the participant was adhering to all of the necessary components of the starting position, making corrections when necessary (see Starting Position). Once the participant was in the correct starting position, the researcher began video recording, after which he said "begin when you are ready". The participant then performed one repetition of the squat from start to finish. Once the participant was finished with the repetition of the squat, the researcher stopped recording the participant. At this point the participant was again in the starting position for the squat. After a 10 to 15 second delay, the process outlined within this paragraph repeated itself again. This continued until five repetitions had been completed. Once five repetitions had been completed, the participant set the bar on the ground and awaited further instruction. No feedback was provided at any time during the initial, mid, post, or retention tests.

Video Model

A video of an expert model performing one repetition of the squat was shown at various times. This video was captured, using Dartfish 4.0.9.0, and shown using Windows Movie Maker (which comes standard with many windows operating systems). The model, who was a NSCA Certified Strength and Conditioning Specialist, was wearing appropriate attire, so that various components of her performance could easily be observed. The video model conformed to all components of the squat except for component 7, as her knees came past her toes slightly (which was pointed out to participants prior to viewing the model near the beginning of the study, and again prior to viewing the model near the beginning of day 2).

Practice Blocks

The following process took place for each block of 10 trials. At the beginning of each block, the participant viewed the video model one time. The participant performed each trial after the researcher told him/her to do so. Before each feedback trial, the researcher began recording the participant, after which he told the participant to begin the movement. (Non-feedback trials were not recorded.) After the trial, the researcher stopped recording, and feedback was provided after which the above process continued. At the completion of trial 10, the above process stopped. At this point the block was completed, and the researcher verbally checked to ensure that the participant was feeling ok, and was not experiencing any discomfort. Then the researcher made one or two motivational statements from the motivational statement list (see appendix L) before continuing on with any successive blocks or other procedures. After the provision of feedback following feedback trials, before the commencement of the next trial, the researcher occasionally choose to remind the participant that he/she could refer to the things posted on the left wall at any time. When the researcher did this, he also reminded the participant that this was never required, but it was always an available option.

Procedure

Each participant came to the testing location once per week on the same weekday, for three consecutive weeks. On the first day, each participant came in during a forty-five minute block of time. On the second day, each participant returned for an additional forty-five minute block of time. On the third day, each participant returned for a 15 to 20 minute block of time.

Day 1

When the participant arrived, the researcher asked the participant to fill out an informed consent form (see appendix M). Next the researcher read a pre-experimental statement (see appendix N) to the participant. This statement was designed to inform the participant as to what would take place during the study, as well as to explain the purpose of the video model, the pictures of the model, the squat components list, the list of corrective statements, and so forth.

Next, the researcher demonstrated the proper technique for the squat one time. The initial test for the study was then administered (See Initial, Mid, Post, and Retention Tests).

Preliminary viewing of model. The participant viewed the video model six times. To begin, the video was paused, with the expert model at the previously defined starting position for the squat. The researcher indicated (and pointed out when possible) the six starting position components. The researcher then explained that these components were to be adhered to throughout the course of the movement. The video was then played for the participant once.

The researcher positioned the video so that it was paused at its starting point, and pointed out components 1-3. The researcher explained that these components were to be adhered to throughout the course of the movement. The video was then played a second time for the participant so that he/she could view how these components of the squat did not change as the model performed the movement. This process continued for four more times while the participant adhered to components 4-5, 6-7, 8, and 9-10 respectively. At this point the preliminary viewings were complete.

The researcher then read the appropriate set of instructions for day one based on the group that the participant was in (see Appendix J). After this, the participant performed 3 blocks of 10 trials with feedback administered following every second trial. Following the completion of the three blocks, the participant was encouraged to stretch his/her quadriceps, and hamstrings, for 3-5 minutes before leaving the testing area.

Day 2

First, the participant performed the mid-test. Next, he/she viewed the video model four times (similar to day one) while focusing on components 4-5, 6-7, 8, and 9-10 respectively. The starting position and components 1-3 were ignored during the viewings as they were much easier to master than components 4-10. Following the viewings, the researcher read the appropriate set of instructions for day two depending on which group the participant was in (see appendix J). Next the participant performed 5 blocks of 10 trials of the squat, with feedback being administered following trials 3, 6, and 9 of each block (see blocks of 10 trials). After the five blocks, the post-test for the study was administered. Following the post-test, the participant was encouraged to stretch his/her quadriceps for 3-5 minutes before leaving the testing area.

Day 3

The retention test was administered. After the completion of the retention test, the participant was asked to answer the Post-Study questions (see Appendix O). Following all data collection, the researcher took the opportunity to help the participant correct aspects of squatting form that he/she was still struggling with if necessary.

Scoring Process and Data Analysis

Each participant's score for the initial test was determined in the following manner. The researcher reviewed each of the five trials for the test. For each of the 10 components of the squat that were performed correctly on each trial, one point was awarded (for a possible maximum score of 10 on each trial). The scores for each of the five trials were then summed with a possible maximum score of 50. This test score served as the dependent variable for the statistical analysis. The same process was used to determine each participant's score on the mid-test, the post-test, and the retention test. After scores for each of the tests were determined, the data were analyzed using a 4 (Test) * 2 (Group) * 2 (Gender) mixed ANOVA, using SPSS for Windows version 16.

Validation of Scoring

For validation purposes, sixteen randomly selected tests (including some initial, mid, post, and retention tests) were rated by an ACSM certified strength and conditioning specialist. These ratings were then compared to the researcher's ratings for the same sample using SPSS for Windows version 16.0. Concurrent validity was calculated using an interclass correlation coefficient. Concurrent validity was found to be good with the *R* value = .871.

Additional Analyses

The researcher also determined on what percentage of trials participants from the self-control group chose video feedback on day 1, day 2, and overall. The same was done for males within the group, as well as females within the group. These data were analyzed using a 2 (Day) * 2 (Gender) mixed ANOVA.

Lastly, to shed some light on whether one type of feedback (video or verbal) was more effective than the other, participants were arranged into categories based on the amount of video feedback they had received. Categories contained those who received video feedback on 65% of feedback trials or more, those who received video feedback on 40 to 60% of feedback trials, and those who received video feedback on 35% of feedback trials or less respectively. A 3 (Category) * 4 (Test) mixed ANOVA was used to analyze these data.

Chapter 4

Results and Discussion

The results section of this chapter begins by briefly discussing the characteristics of the participants. The main findings are then discussed in terms of group differences and in terms of gender. Lastly, information about percentages of video feedback chosen by the self-control group is provided.

The discussion section of this chapter reviews the purpose, methods, and results. Next, the duration, skill level of learners, and relative complexity of the skill are discussed followed by the duration of the two different types of feedback. The efficacy of video feedback versus verbal feedback are discussed and compared to that of other self-control studies in terms of results as well as a possible primary reason for those results.

Results

Participant Characteristics

Twenty-four volunteer participants (10 males and 14 females) were recruited from various classes at the State University of New York College at Cortland. Students ranged in age from 18-22 years (M = 19.92, SD = 0.97).

Group Differences

When examining test scores for each group, group performances showed improvement across time from the initial test through the post-test, and regressed between the post-test and the retention test (see Figures 4 and 5). Comparison of the two groups and genders are illustrated in figure 6. While the self-control females appear

somewhat higher in the post-test and retention test, all groups appear fairly similar for each of the four tests.

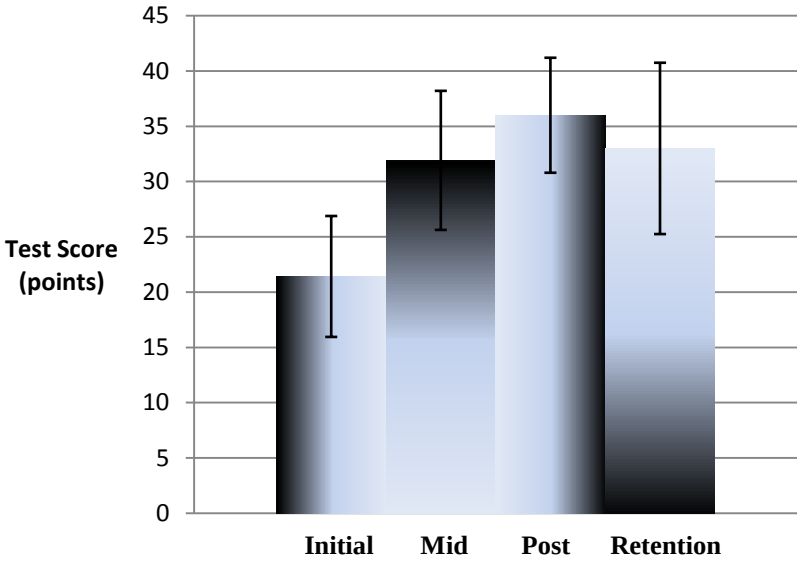

Figure 4. Mean test scores for the self-control group (bars represent *sd*).

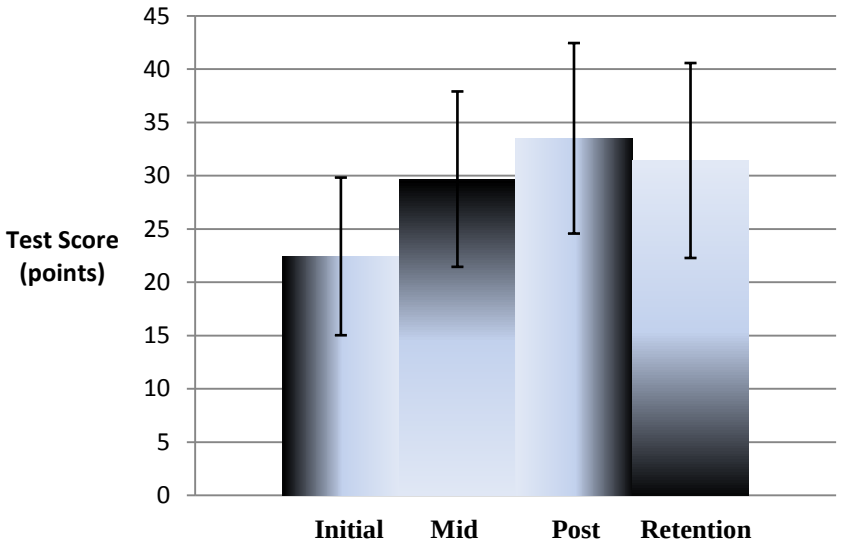

Figure 5. Mean test scores for the yoked group (bars represent *sd*).

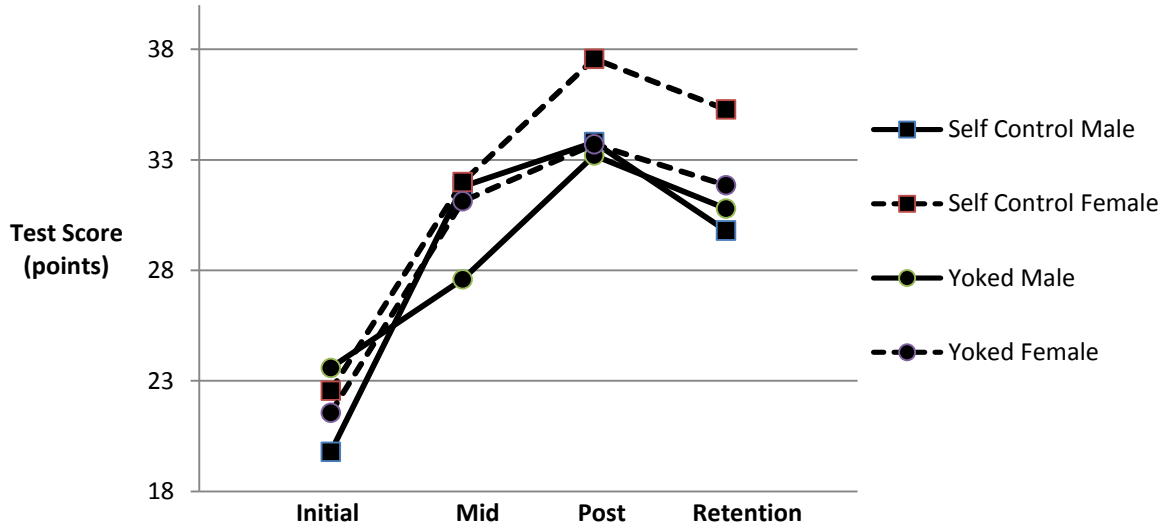

Figure 6. Mean initial, mid, post, and retention test scores for males and for females in the self-control and yoked groups.

The main effect of Test (comparing initial, mid, post, and retention tests) was significant, $F(3,60) = 40.767$, $p = < .0005$, partial $\eta^2 = .67$. Employing the Bonferroni post-hoc test, significant differences were found between the initial test and each of the other three tests ($p < .0005$). Initial test scores ($M = 21.92$, $SD = 6.39$) were significantly lower than the mid ($M = 30.79$, $SD = 7.25$), post ($M = 34.75$, $SD = 7.25$), and retention tests ($M = 32.21$, $SD = 8.33$). A significant difference was also found between the mid-test and the post-test ($p < .05$) with the post-test scores being significantly higher. There were no other significant differences found between any of the tests.

The main effect of group was not significant, $F(1,20) = .168$, $p = .686$, partial $\eta^2 = .008$. The main effect of gender was not significant, $F(1,20) = .472$, $p = .500$, partial $\eta^2 =$

.023. The Group by Test interaction was not significant, $F(3,60) = 1.076$, $p = .366$, partial $\eta^2 = .05$. The Gender by Test interaction was not significant, $F(3,60) = 0.481$, $p = .697$, partial $\eta^2 = .02$. The three-way interaction between Test, Group, and Gender was not significant, $F(3,60) = 1.224$, $p = .309$, partial $\eta^2 = .06$.

Percent of Video and Verbal Feedback Chosen

On day one, participants from the self-control group chose video feedback 47% of the time. On day 2, they only chose video feedback 39% of the time. Overall, they chose video feedback on 43% of trials. Overall, males chose video feedback 50% of the time, while females chose it only 38% of the time. Additionally, males chose virtually the same percentages of video feedback on day one (51%) and day two (49%). Females chose video feedback more often on day one (44%) than on day two (32%). The information contained in this paragraph is illustrated below (see Figure 7).

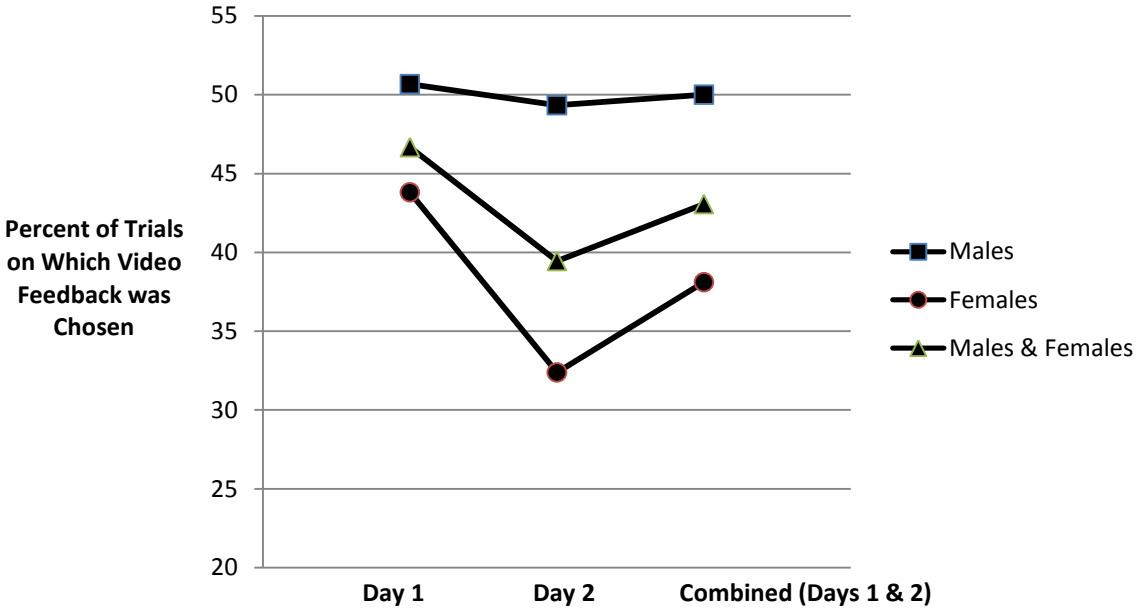

Figure 7. Mean percentage of time participants received video feedback by day and gender.

When comparing the percent of video feedback, the main effect of Day was not significant, $F(1,10) = 2.312$, $p = .159$, partial $\eta^2 = .188$. The Day by Gender interaction was not significant, $F(1,10) = 1.447$, $p = .257$, partial $\eta^2 = .126$. The main effect of Gender was not significant, $F(1,10) = 0.492$, $p = .499$, partial $\eta^2 = .047$. Therefore, participants were fairly consistent with their choices and these choices did not vary significantly between men and women.

Discussion

The present study was designed to examine whether or not allowing learners to determine the type of feedback they received (video or verbal) would benefit them more than not giving them a say in the matter. Each participant from the self-control group was permitted to choose the type of feedback he/she would receive following each feedback trial, prior to receiving the feedback. Each participant from the yoked group was matched with a counterpart from the self-control group in terms of the type of feedback that was provided following each feedback trial. In other words, the amount of each type of feedback provided (video and verbal) was equated for both groups.

Participants were tested shortly after they arrived on the first day of the intervention. They were also, tested at the beginning and the end of the second day of the study, as well as when they came in on the third day of the study for retention. Groups were not significantly different (in terms of their proficiency) prior to the intervention and they performed significantly similarly to each other on each of the tests. Overall, participants improved significantly across time with increases in proficiency from the initial test on day one, to the mid-test at the beginning of day two, and from the mid-test at the beginning of day two to the post-test at the end of day two. Their performance

decreased between the post-test at the end of day two to the retention test at the beginning of day three.

In short, the difference between groups was the ability to control the type of feedback they received. They were not significantly different in terms of their levels of squatting proficiency prior to the study as shown by the initial test. They both showed significant improvements throughout the duration of the study, but they did not perform significantly differently on the mid-test, the post-test, or the retention test. The hypothesis that the learning environment which allowed learners to determine which type of feedback they received would result in greater learning than the learning environment which did not, was not supported.

Duration

As indicated by Darden and Shimon (2000), and Rothstein and Arnold (1976), video feedback must be employed often if it is to be effective. One would anticipate that if this study was of greater duration, and if video feedback would have been employed more often, the results might have been different.

While the notion put forth by the previous paragraph is worth considering, it seems equally likely that increasing the duration of the present study would not have significantly influenced the effectiveness of the video feedback. The study by Oñate et al. (2005) was of much shorter duration than the present study, and the study by Del Rey (1971) was similar in duration to the present study. Both of these studies showed video feedback to be more effective than other treatments, while the present study did not. Additionally, other studies which were of lengthy duration produced results which were similar to those of the present study. A good example of this was Penman et al. (1968),

who required participants to meet on two days per week for twelve weeks, but still found no differences between groups. While duration is an important factor which affects the efficacy of video feedback, it is not the only factor to be considered.

Skill Level of Learners

The novice skill level of learners in the present study could have negatively influenced the efficacy of video feedback just as Darden and Shimon (2000), Kernodle et al. (2001), Rikli and Smith (1980), and Selder and Del Rolan (1979), might have suggested. However, it is also a possibility that this was not a factor in the present study, as a fair portion of research has shown inexperienced learners to benefit as a result of video feedback. This notion is supported by the results of Del Rey (1971), and Neufeld and Neufeld (1972), which found video feedback to be effective, although they likely had novice learners. Oñate et al. (2005) possibly provide further support to this notion as their study showed video feedback to be effective even though participants were not likely to have been experienced at the specific task employed. Perhaps this was because the task employed by the study was not particularly difficult. Similarly, although participants in the present study were novices, the skill was not an extremely difficult one to learn. It is possible that relative skill complexity had a hand in its results due to this factor.

If the effectiveness of video feedback had been greater for any of the aforementioned reasons (duration, skill level of learners, or relative skill complexity), it is possible that these effects might have bolstered the performance of the self-controlled group more than that of the yoked group (or vice versa). However, this can not be determined without additional research.

Duration of Video and Verbal Feedback

A factor that may well have influenced the efficacy of video feedback is the time it took to provide video feedback versus verbal feedback within the present study. Although efforts were made to equate the time it took to provide both types of feedback, learners unanimously indicated that video feedback was more time consuming than verbal feedback. While the reality of the perceived time differences is questionable, participants felt that there was a difference (see Appendix P). It should be noted that 5 out of the 12 participants from the self-control group indicated that they chose verbal feedback over video feedback (at least once) because they thought it would take less time. This took place despite the fact that 8 out of 12 of them indicated that they felt video feedback was more effective than verbal feedback. Ten of the 12 members of the yoked group (who had no choice) indicated that they felt video feedback was more effective than verbal feedback.

The possibility exists that although many learners generally felt video feedback was most effective, they may not have felt that it was needed in high volumes to be maximally effective. Perhaps this accounts for part of the reason why they chose video feedback less often than verbal feedback. Participants from other self-control studies choose varying frequencies of feedback, video modeling, or assistive device use which ranged from 5.8% to 95 and 99% (Chen et al., 2002; Chiviacowsky & Wulf, 2002; Chiviacowsky et al., 2008; Janelle et al., 1995; Janelle et al., 1997; Wulf et al., 2005; Wulf & Toole, 1999; Wulf et al., 2001). The frequencies they chose, whether low or high, seemed to benefit learning more so than rigid feedback schedules. One can only

speculate as to whether the frequency of video feedback (43% of feedback trials) for the present study was optimal.

The fact that most learners indicated that they felt video feedback was more effective than verbal feedback does not mean that they were correct, or that they would have been correct had video feedback been employed under more optimal conditions. Rikli and Smith (1980) did not find video feedback to be extremely effective. This was despite the fact that 86% of learners indicated that they felt it was effective. The findings of the present study and that of Rikli and Smith (1980) lay grounds for the possibility that, in certain situations, learners may not necessarily be able to effectively determine which type of feedback will benefit them most.

Video Feedback versus Verbal Feedback

While the things discussed within the previous section may or may not have influenced the effectiveness of video feedback, the finding remains that both video and verbal feedback were shown to be equally effective in the present study. For this reason it seems likely that the lack of differences between the self-control, and the yoked groups did not result because one type of feedback (either video or verbal) was more effective than the other.

In order to gain insight as to whether or not one type of feedback was more beneficial than the other, the data were divided into three different categories. The first category consisted of participants who received video feedback following 65% or more of feedback trials. The second category contained participants who received video feedback following 40 to 60% of feedback trials. The third category contained participants who received video feedback following 35% of feedback trials or less.

The data were analyzed using a 3(Category) * 4(Test) mixed ANOVA. While the main effect of Test was still significant: $F(3,57) = 34.624$, $p = < .005$, partial $\eta^2 = .646$, there was no significant Category by Test effect: $F(6,57) = 1.067$, $p = .393$, partial $\eta^2 = .10$. The main effect of Category also failed to reach significance: $F(2,19) = 1.079$, $p = .360$, partial $\eta^2 = .10$, therefore both types of feedback (video and verbal) were equally effective. In light of this finding, the study's results, in terms of the benefits of self-control, must not have been affected as a result of one type of feedback being better than the other. Some participants definitely preferred one type of feedback over the other (as shown by the types of feedback they chose most often). However, this seems not to have had a negative influence on the yoked group, some of whose members were likely provided most often with their least preferred type of feedback. Regardless of learner preference or learner choice, both types of feedback were similarly effective. This would partially account for both the lack of differences between the self-control group, and the yoked group, as well as the lack of differences between participants who received varying amounts of video, and verbal feedback.

Participants' answers to various post study questions revealed that there were various reasons for the selections (in terms of feedback type) made by the self-control group. The most common reason video feedback was chosen (as indicated by participants in the self-control group) was because it allowed them to see the mistakes they were making so that corrections could be made. Among the reasons verbal feedback was chosen, according to self-control participants was that they simply liked it better, they already knew what they had done wrong so they did not need to see it, or because it was perceived to take less time. Regardless of the reasons why various types of feedback

were selected, participants did not appear to be adversely affected due to the selections they made.

Comparison with other Self-Control Studies

While the only focus of the present study was to examine the effects of allowing learners to control the mode of feedback, perhaps the lack of control over feedback frequency is a key difference from other self-control research in motor learning. Of the self-control studies reviewed in this paper, which allowed learners to control feedback frequency, all of them found self-control to be effective (Chen et al., 2002; Chiviacowsky & Wulf, 2002; Chiviacowsky et al., 2008; Janelle et al., 1995; Janelle et al., 1997; Titzer et al., 1993). It may be that participants in these studies reaped the benefits associated with the feedback they were getting, while minimizing the detrimental effects of receiving too much feedback or receiving feedback at the wrong time.

Chiviacowsky and Wulf (2002, 2005) suggested that self-control is effective because it allows learners receive feedback when it is needed. The present study supports the previous notion in that it did not allow learners to control feedback frequency, and it found self-control to be no more effective than the lack thereof. Providing further support to this notion is the study by Barney and Lee (2007) which compared three groups, one which received feedback based on their best trial, one which received feedback on their worst trial, and one which received feedback based on the trial of their choosing following each series of three trials. The group which received feedback based on their worst trials demonstrated superior advantages in learning. Perhaps the reason this study failed to show the advantages of self-control is because it (like the present study) did not allow learners to control feedback frequency. The six studies which did

give learners full control over feedback frequency did show self-control to be effective (Chen et al., 2002; Chiviacowsky & Wulf, 2002; Chiviacowsky et al., 2008; Janelle et al., 1995; Janelle et al., 1997; Titzer et al., 1993). All things considered, it seems highly probable that when learners have control over feedback frequency (as opposed to an aspect of feedback that is less important), they benefit as a result.

Other research in the area of self-control has shown it to be beneficial when learners are permitted to choose the frequency at which they used an assistive device (Wulf & Toole, 1999; Wulf et al., 2001), or when learners are permitted to control the frequency at which they view a video model (Wulf et al., 2005). A commonality between these studies and the studies which allowed learners to control feedback frequency (aside from the fact that they found self-control to produce positive results) is that they looked at the effects of allowing learners to have total control over the frequency at which a beneficial treatment was employed. The same can not be said about the present study.

Perhaps learners in most of the previously mentioned self-control studies benefited as a result of their ability to receive a beneficial treatment whenever they needed it. It is also a distinct possibility that learners in self-control group of the present study (as well as those in the study by Barney and Lee, 2007) failed to show greater improvements than the yoked group because they did not have this ability.

Summary

Allowing learners to choose the type of feedback they receive following feedback trials as they learned the squat did not produce greater benefits than when this choice was made for them. In fact, self-control was found to be no different than experimenter controlled; a result which contrasts with the majority of previous motor learning research

on this particular topic. The most prominent difference between this study and other motor learning studies which looked at the efficacy of self-control is that most other studies allowed the learner to have full control over the dependent variable (feedback frequency or other feedback related variables, video modeling frequency, or frequency of assistive device use). On the other hand, the present study only examined the effects of allowing learners to control the type of feedback they received. Perhaps this had a hand in the outcome. Other possible reasons for the results could be attributed to the duration of the study, the type and complexity of the skill used, and the level of the learners used.

Chapter 5

Summary, Conclusions, and Recommendations

Summary

The purpose of the present study was to determine whether a learning environment where participants were permitted to choose the type of feedback they received would be more beneficial than a learning environment in which they were not given this choice. Past research has shown self-control to be beneficial (Chen et al., 2002; Chiviacowsky & Wulf, 2002, 2005; Chiviacowsky, et al., 2008; Janelle et al., 1995; Janelle et al., 1997; Titzer et al., 1993; Wulf, & Toole, 1999; Wulf, et al., 2001; Wulf et al., 2005). While previous research has explored the effects of giving learners control over various aspects of their learning environments, no previous research has investigated the effects of allowing learners to choose the type of feedback they received. The present study sought out to explore this.

Twenty-four college-aged students were recruited as participants. They were divided into two groups (one which controlled the type of feedback they received, and one which did not). On the first day of the intervention they performed an initial test to determine their level of proficiency in performing proper squatting form. They then practiced the squat (for three trials in blocks of 10). After one week, participants were retested (mid-test), after which they performed 5 more blocks of 10 repetitions of the squat (one repetition at a time), and ended with a post-test. One week later, participants came in for a retention test.

Form assessment scores from the four tests were analyzed using a mixed ANOVA design. There were no significant differences found between the self-control and the

yoked group. These findings contrast with the majority of motor learning research on self-control. Perhaps this finding hinges on the one major difference between the present study and a number of other self-control studies referenced in this paper, the ability to have a great degree of control over a variable of interest. While the present study explored the effects of giving learners control over the type of feedback, other studies looked at the effects of giving learners control over the frequency of feedback (for example). Other factors that could account for the results included the duration of the study, the type and complexity of the skill learned, and the skill level of the learner.

Findings

The present study resulted in the following findings:

1. The hypothesis that the learning environment which allowed learners to determine which type of feedback they received would result in greater learning than the learning environment which did not was not supported.
2. Video and verbal feedback were equally effective in learning proper squatting form.

Conclusions

The present study resulted in the following conclusions:

1. Self-control for the type of feedback (video versus verbal) is not a determinant in learning the form of the squat for college-aged novice lifters.
2. As some learners may be less receptive to video feedback than others, providing them the choice of video or verbal feedback may maximize comfort without hindering learning or performance.
3. Gender is not a detrimental factor to the influence of feedback type on performance or learning of the squat.

Recommendations

Based on the findings of the present study, future aspects of research should include the following:

1. Researchers interested in self-control in motor learning should investigate the effects of allowing learners to control the frequency of various aspects of the learning environment coupled with the type of feedback. Past research has explored allowing learners to control the frequency at which an important variable (feedback frequency and other feedback related variables, video modeling frequency, frequency of assistive device use) occurs. The vast majority of this research has found self-control to be effective when learners dictate the frequency at which they receive a beneficial treatment. Consequently, it appears to be a fruitful avenue for continued exploration.
2. Although the two types of feedback employed in the present study were very different, they were designed to provide learners with essentially the same pieces of information. Future insights into the benefits of self-control might be gained by investigating the effects of allowing learners to choose between pieces of information that are dissimilar (such as that obtained via viewing a video model versus receiving corrective feedback).
3. Outcomes from informal post-study queries suggest that the time it took to provide each type of feedback influenced learner's choice. Future research which explores the effects of allowing learners to choose the type of feedback they receive should make every effort to equate duration for various feedback types. Additionally, an attempt should be made to convey to learners that such an

effort has been made. Whether video feedback in the present study was or was not more time consuming, learners felt that it took longer to provide than verbal feedback.

4. Another possible fruitful area of exploration might include investigating the research question imposed by the present study as it applies to the learning of different skills. Although the present study has shown that allowing learners to choose the type of feedback they received did not benefit them as they learned the squat, it has not yet been investigated in terms of other motor skills.
5. Even though learners had sufficient time to improve and learn squatting form, it is possible that the present study might have produced different results had it been of a longer duration. Future research examining the efficacy of allowing learners to choose the type of feedback they receive may need to provide feedback over a longer time period.

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Appendix A

SUNY CORTLAND INSTITUTIONAL REVIEW BOARD APPROVAL

SUNY Cortland
Institutional Review Board

MEMORANDUM

To: Josh Davis

From: Leslie Eaton, Associate Professor of Psychology
Institutional Review Board Administrator

Date: 03-27-09

RE: Institutional Review Board Approval

In accordance with SUNY Cortland's procedures for human research participant protections, the protocol referenced below has been approved for a period of one year:

Title of the study:	Effects of Self-Controlled Feedback on the Squat	
Level of review:	Expedited	**Protocol number:** 809011
Project start date:	Upon IRB approval	**Approval expiration date*:** 03-26-10

* **Notes:** *Please include the protocol expiration date to the bottom of your consent form.*
For information about continuation policies and procedures, visit http://www.cortland.edu/irb/Applications/continuations.html

The federal Office for Research Protections (OHRP) emphasizes that investigators play a crucial role in protecting the rights and welfare of human subjects and are responsible for carrying out sound ethical research consistent with research plans approved by an IRB. Along with meeting the specific requirements of a particular research study, investigators are responsible for ongoing requirements in the conduct of approved research that include, in summary:

- obtaining and documenting informed consent from the participants and/or from a legally authorized representative prior to the individuals' participation in the research, unless these requirements have been waived by the IRB;
- obtaining prior approval from the IRB for any modifications of (or additions to) the previously approved research; this includes modifications to advertisements and other recruitment materials, changes to the informed consent or child assent, the study design and procedures, addition of research staff or student assistants, etc. (except those alterations necessary to eliminate apparent immediate hazards to subjects, which are then to be reported by email to irb@cortland.edu within three days);
- providing to the IRB prompt reports of any unanticipated problems involving risks to subjects or others;
- following the principles outlined in the Belmont Report, OHRP Policies and Procedures (Title 45, Part 46, Protection of Human Subjects), the SUNY Cortland College Handbook, and SUNY Cortland's IRB Policies and Procedures Manual;
- applying for continuation requests, consistent with SUNY Cortland Policies and Procedures and federal guidelines, prior to the expiration of this approval; and,
- maintaining records as required by the HHS regulations and NYS State law, for at least three years after completion of the study.

Given the topics and methods of research conducted at SUNY Cortland, investigators frequently possess multiple and possibly conflicting role responsibilities. A principle investigators primary duty is to ensure the protection of research participants during recruitment, participation, and after the study has concluded. In the event that questions or concerns arise about multiple roles or the conduct of research at SUNY Cortland, contact the IRB by email irb@cortland.edu or by telephone at (607)753-2079. You may also contact a member of the IRB who possesses expertise in your discipline or methodology, visit http://www.cortland.edu/irb/members.html to obtain a current list of IRB members.

Sincerely,

Leslie Eaton

For more information about SUNY Cortland's Human Participant Protection Program, visit us on the web:
http://www.cortland.edu/irb

Old Main, Room 134-B • P.O. Box 2000 • Cortland, NY 13045
Phone: (607) 753-2079 • Fax: (607) 753-5437 • email: irb@cortland.edu

Appendix B
Explanation of the Study

My name is Josh Davis. I am a grad student in the Kinesiology Department at SUNY Cortland. The reason I am here is to present you with the opportunity to participate in a motor learning study which I will be conducting.

We all know that feedback is beneficial for learning. For example, if I were teaching first grade students to properly throw a ball, they would learn faster if I gave them feedback following various throws. When giving them feedback, I would tell them what to do in order to perform better on their next throw. I might say something like "step with your other foot", or "bring your arm way back before you throw the ball".

Motor learning studies have also shown that if too little or too much feedback is provided, less learning occurs. For example, learners will not have as much opportunity to benefit from feedback if it is only provided after every tenth trial. However, if feedback if provided following every trial, it can act as a crutch, and when it is removed, performance suffers. In short, just the right amount of feedback is best for learning.

An alternative to choosing when to provide learners with feedback is to allow them to make this choice for themselves. Motor learning research has shown that allowing learners to choose <u>when</u> they receive feedback is more beneficial than making this decision for them. However, no research has been conducted to look at the effects of allowing learners to choose the <u>type</u> of feedback they receive. The purpose of my study is to explore this by comparing learning improvements in two groups as they practice the squat.

One group will be allowed to choose the type of feedback they receive following various trials. Following each feedback trial, they will be given the choice between video and verbal feedback. Learners in a second group will be matched with the learners in the first group in terms of the type of feedback they receive. For example, if participant 1 from the first groups chooses verbal feedback on trial two, and video feedback on trial four, then participant 1 from the second group will be provided with verbal feedback on trial two, and video feedback on trial four. In short, the only difference between groups will be the ability (or inability) to choose the type of feedback received.

Following data collection, group improvements will be compared in order to determine if allowing learners to choose the type of feedback they received was more effective than not doing so. To participate in this study, you must be able to commit to 2 one-hour sessions on 2 separate days, and a shorter session on a third day.

(After imparting the information on this form, the researcher will provide students who wish to participate with the Information Form, and the Participant Recruitment Form. Prospective participants will fill out and the Participant Recruitment Form and return it to the researcher. The researcher will indicate to students that they will be contacted if they fit the necessary criteria to serve as participants.)

Appendix C

INFORMATION FORM

What to Wear:

Spandex shorts and spandex shirts are preferable. However, athletic shorts that do not come down to the knees, and tighter fitting t-shirts will be acceptable. Please do not wear baggy clothes. Additionally please wear sneakers, and make sure you wear the same pair of sneakers on each of the three days.

Directions to the Squash Court:

1. The squash courts are in the basement of Park Center. To get to the area of the basement where they are located, take the stairway that is across from the phys ed equipment room and the men's main locker room.
2. Turn right after exiting the stairwell, then go down the hallway that is immediately on your right.
3. The squash court for the study will be the first one on your right.
4. Make sure that you do not hit your head when you enter the squash court.

If contacted for participation in the study, indicate the time slot you committed to. Remember, this time slot will be on the same time of the same weekday for three weeks in a row.

Day:_____ Time:_____ Dates of the Three Days _____ _____ _____

Appendix D

PARTICIPANT RECRUITMENT FORM

First Name: _____ Last Name:_____

Gender:_____ Age:____ Last 4 digits of C#_____

Email: _____ Phone:_____

Do you have any back or knee injuries? _____

Do you have any physical limitations which would put you at risk for injury during physical activity (specifically the performance of the squat)? _____

If you answered yes to the previous question please explain. _____

Indicate the number days out of your whole life during which you have performed the squat.____

Please circle all available time slots during which time you will be available to participate in the study. If you are available during a time slot that is open, and you fit the necessary criteria, the researcher will contact you and offer you a chance to participate. If chosen to participate in the study, you will be required to come to the same time slot on the same day of each week, for three weeks in a row. Please only circle time slots during which you will be available on a weekly basis.

Monday	**Tuesday**	**Wednesday**	**Thursday**	**Friday**
6am-7am	6am-7am	6am-7am	6am-7am	6am-7am
7am-8am	7am-8am	7am-8am	7am-8am	7am-8am
8am-9am	8am-9am	8am-9am	8am-9am	8am-9am
9am-10am	9am-10am	9am-10am	9am-10am	9am-10am
10am-11am	10am-11am	10am-11am	10am-11am	10am-11am
11am-12pm	11am-12pm	11am-12pm	11am-12pm	11am-12pm
12pm-1pm	12pm-1pm	12pm-1pm	12pm-1pm	12pm-1pm
1pm-2pm	1pm-2pm	1pm-2pm	1pm-2pm	1pm-2pm
2pm-3pm	2pm-3pm	2pm-3pm	2pm-3pm	2pm-3pm
3pm-4pm	3pm-4pm	3pm-4pm	3pm-4pm	3pm-4pm
4pm-5pm	4pm-5pm	4pm-5pm	4pm-5pm	4pm-5pm
5pm-6pm	5pm-6pm	5pm-6pm	5pm-6pm	5pm-6pm

Appendix E

FEEDBACK CHOICE SHEET

On this sheet, the researcher will circle the type of feedback chosen by the self-control participant following each feedback trial. As the yoked counterpart completes each feedback trial, he/she will receive the type of feedback circled.

Self-Control Participant:

Last 4 Digits of Student ID #:_____ Time Slot:_____

Yoked Counterpart:

Last 4 Digits of Student ID #:_____ Time Slot:_____

DAY 1:

Block 1	**Block 2**	**Block 3**
Trial 2: video verbal	Trial 2: video verbal	Trial 2: video verbal
Trial 4: video verbal	Trial 4: video verbal	Trial 4: video verbal
Trial 6: video verbal	Trial 6: video verbal	Trial 6: video verbal
Trial 8: video verbal	Trial 8: video verbal	Trial 8: video verbal
Trial 10: video verbal	Trial 10: video verbal	Trial 10: video verbal

DAY 2:

Block 1	**Block 2**	**Block 3**
Trial 3: video verbal	Trial 3: video verbal	Trial 3: video verbal
Trial 6: video verbal	Trial 6: video verbal	Trial 6: video verbal
Trial 9: video verbal	Trial 9: video verbal	Trial 9: video verbal

Block 4	**Block 5**	**Block 6**
Trial 3: video verbal	Trial 3: video verbal	Trial 3: video verbal
Trial 6: video verbal	Trial 6: video verbal	Trial 6: video verbal
Trial 9: video verbal	Trial 9: video verbal	Trial 9: video verbal

Appendix F

Feedback List

Component 1 - Head

1. Your head was not pointing straight ahead or slightly upward throughout the movement.
    1a. You dropped your head too far during the course of the movement.
    1b. You raised your head too high during the course of the movement.

Component 2 - Elbows

2. Your elbows were not up and back.
    2a. Your elbows were not up high enough.
    2b. Your elbows were not back far enough.

Component 3 - Bar

3. The bar was not at base of your neck, resting on the back portions of your shoulders.

Component 4 - Back

4. Your back did not stay flat during the movement.
    4a. Your back rounded forward during the movement.

Component 5 - Chest

5. Your chest was not up and puffed out throughout the course of the movement.

Component 6 - Feet

6. The bottoms of your feet were not in contact with the floor for the entire movement.
    6a. Your heels did not stay on the ground for the entire movement.
    6b. Your toes did not stay on the ground for the entire movement.

Component 7 - Knees

7. Your knees went past your toes.

Component 8 – Hips & Knees

8. Your hips and your knees didn’t bend and/or straighten at the same rate.

Component 9 - Control

9. You didn’t perform the movement in a controlled manner.

Component 10 - Parallel

10. Your thighs were not parallel to the ground at the end of the down phase.

Appendix G

Squat Components List

1. The head is pointed straight ahead or tilted slightly up throughout the movement.
2. The elbows are up and back.
3. The bar is at base of the neck, resting on the back portions of the shoulders.
4. The back stays flat (does not round forward).
5. The chest is up and is puffed out throughout the course of the movement.
6. The bottoms of the feet are in contact with the floor for the entire movement.
7. The knees don't move past the toes.
8. The knees and hips bend/straighten at the same rate.
9. The down phase and up phase are performed in a controlled manner with no bouncing or jerky movements.
10. The down phase ends with the thighs parallel to the ground.

Appendix H

Pictures of the Video Model

Following are the three pictures of the video model that were posted on the left wall of the racquetball court. Each picture was in color. Pictures were enlarged so that each one fit on its own separate page.

Up Position

Mid Position

Down Position

Appendix I

Corrective Feedback List

1. Possible ways to correct an error in component one. (Your head was not pointing straight ahead or slightly upward throughout the movement.)
    a. If your head dropped, make an effort to keep it up next time.
    b. If your head was tilted too far back, make an effort not to tilt it back so far next time.

2. Possible ways to correct an error in component two. (Your elbows were not up and back.)
    a. If your elbows were not high enough, lift them up higher next time.
    b. If your elbows were not back far enough, bring them back farther next time.
    c. Your arms should look like a 'W'.

3. Possible ways to correct an error in component three. (The bar was not at base of your neck, resting on the back portions of your shoulders.)
    a. If you held the bar too high, bring it down so that it rests on the backs of your shoulders.
    b. If you held the bar too low, move up higher so that it can rest on the backs of your shoulders.

4. Possible ways to correct an error in component four. (Your back did not stay flat during the movement.)
    a. Make sure you keep your chest up and out throughout the movement.
    b. Keep your back straight throughout the movement.
    c. If your back rounded forward, concentrate on keeping your chest and your head up throughout the course of the movement.

5. Possible ways to correct an error in component five. (Your chest was not up and puffed out throughout the course of the movement.)
    a. Focus on keeping your chest up and sticking it out.

6. Possible ways to correct an error in component six. (The bottoms of your feet were not in contact with the floor for entire movement.)
    a. If your heels came off of the ground, try putting more of your weight on them rather than on other parts of your feet.
    b. If your heels came off of the ground, try sticking your butt back farther as if you were trying to sit in a chair.
    c. If your toes came off the ground, concentrate on distributing your weight across the entire bottoms of your feet.
    d. Whether your heels came off the ground, or your toes came off the ground, you may be able to correct the problem by bending more at the hips.

7. Possible ways to correct an error in component seven. (Your knees went past your toes.)
    a. Focus on not allowing your knees to go past your toes.
    b. Try bending more at the hips.
    c. Try sticking your butt back farther as if you were trying to sit in a chair.
    d. Try initiating the movement by moving your butt backwards slightly before you start to bend at your knees.

8. Possible ways to correct an error in component eight. (Your hips and your knees didn't bend and/or straighten at the same rate.)
    a. Concentrate on bending and straightening your hips and your knees the same amount and at the same time.
    b. If you failed to bend your hips as much as you bent your knees, bend at your hips more next time.
    c. If you failed to bend your knees as much as you bent your hips, bend your knees more next time.

9. Possible ways to correct an error in component nine. (You didn't perform the movement in a controlled manner.)
    a. Go down more slowly.
    b. Come up more slowly.
    c. Do not bounce (at the bottom).
    d. Do not make any sudden movements.
    e. Try taking two seconds to complete the down phase, and 1 to 1.5 seconds to complete the up phase.

10. Possible ways to correct an error in component ten. (Your thighs were not parallel to the ground at the end of the down phase.)
    a. If you did not go down far enough, try to go down farther.
    b. If you did not go down far enough, spread your feet out more before you begin. This may allow you to go down farther.
    c. If you did not go down far enough, point your toes out (slightly) more before you begin. This may allow you to go down farther.
    d. If you did not go down far enough, try bending your hips more next time. This may help you to maintain your balance, allowing you to bend your knees far enough so your thighs are parallel with the ground.
    e. If you went down too far, do not go down as far next time.

Appendix J

Instructions for Groups (Day 1, and Day 2)

Instructions for Self-Control Group (Day 1)

"You will now be required to practice the squat. Your goal is to perform the squat with the best possible form. I will provide you with feedback following various trials. Following feedback trials, I will ask you to place the bar on the floor, and stay where you are at. I will then ask you if you want to receive video or verbal feedback.

If you choose video feedback, I will tell you to focus on a specific component of the feedback list which is positioned on the wall. (At this point, the researcher will point to the feedback list on the left wall.) You will then be required to watch one video replay of your last performance as you take note of the way you performed the specific component that I pointed out. The replay will be projected on to the wall, to the left of the feedback list.

If you choose verbal feedback, I will watch the video of your previous performance one time on the computer screen, after which I will read one of the components of the feedback list to you. Regardless of whether you choose to receive video or verbal feedback, the component I choose from the list will be the one that I feel you need to improve most on at that time. If you perform all components correctly on a feedback trial, I will tell you this following the trial, instead of providing you with feedback.

Do not forget, you may refer to the corrective feedback list and the pictures of the video model, which illustrate proper form, at any time during the course of this study."

(At this point, the researcher will point out the corrective feedback list, and the pictures of the video model which will be posted to the right of the feedback list on the right side wall of the racquetball court.)

Instructions for Self-Control Group (Day 2)

"You will now be required to practice the squat. Your goal is to perform the squat with the best possible form. Your choice of video or verbal feedback will be provided following every third trial. Both video and verbal feedback will be administered in the same manner that they were administered during our last meeting.

Do not forget, you may refer to the things posted on the wall at any time during the course of this study." (At this point, the researcher will point out the various things posted on the left side wall of the squash court, as well as the purpose of each of these things.) Do you have any questions?

Instructions for Yoked Group (Day 1)

"You will now be required to practice the squat. Your goal is to perform the squat with the best possible form. I will provide you with feedback following various trials. Following feedback trials, I will ask you to place the bar on the floor, and stay where you are at. I will then provide you with either video or verbal feedback.

On trials when video feedback is provided, I will tell you to focus on a specific component of the feedback list which is positioned on the wall. (At this point, the researcher will point to the feedback list on the left wall.) You will then be required to watch one video replay of your last performance as you take note of the way you

performed the component that I pointed out. The replay will be projected on to the wall, to the left of the feedback list.

On trials when verbal feedback is provided, I will watch the video of your previous performance one time on the computer screen, after which I will read one of the components of the feedback list to you. Regardless of whether video or verbal feedback is provided, the component I choose from the list will be the one that I feel you need to improve most on at that time. If you perform all components correctly on a feedback trial, I will tell you this following the trial, instead of providing you with feedback.

Don't forget, you may refer to the corrective feedback list and the pictures of the video model, which illustrate proper form, at any time during the course of this study." (At this point, the researcher will point out the corrective feedback list, and the pictures of the video model which will be posted to the right of the feedback list on the right side wall of the racquetball court.)

Instructions for Yoked Group (Day 2)

"You will now be required to practice the squat. Your goal is to perform the squat with the best possible form. You will be provided with video or verbal feedback following every third trial. Both video and verbal feedback will be administered in the same manner that they were administered during our last meeting.

Do not forget, you may refer to the things posted on the wall at any time during the course of this study." (At this point, the researcher will point out the various things posted on the left side wall of the squash court, as well as the purpose of each of these things.) Do you have any questions?

Appendix K

Pre-Testing Statement

At this point, you will be required to perform a test to determine your level of proficiency in maintaining proper squatting form. You will perform 5 trials. No feedback will be given to you at any time during this test. All I ask is that you attempt to perform the squat with the best possible form on each trial.

Appendix L

Motivational Statement List

1. Nice job on the last ten trials.
2. Don't worry if this seems difficult. It's difficult for most people.
3. You're definitely getting better.
4. I appreciate your effort.
5. Don't worry if I keep pointing out that you are making the same mistake. You may be making the same mistake, but you are getting closer and closer to correcting the mistake.

Appendix M

State University of New York College at Cortland
Consent Form

The research in which you have been invited to participate is being conducted by graduate student Josh Davis of the Kinesiology Department at SUNY Cortland. The researcher requests your informed consent to be a participant in the project described below. This project has the purpose of examining the effects of allowing college aged learners to choose the type of feedback they receive while learning a motor skill. Please feel free to ask about the project, its procedures, or its objectives.

You will be asked to perform the squat (a strength training exercise) for a series of trials on each of two practice days. Your goal for each attempt will be to perform the squat with the best possible form. During each attempt, you will be videotaped. Certain videotaped performances will be used to evaluate your improvement in the performance of the skill or to give you feedback based on your performance. This will take place during 3 different days for no more than one hour each day. There will be approximately 5-7 days between each session. On the third testing session, you will complete a final assessment of your squat technique. This will likely be a shorter session. The opportunity to participate in this study will be made available to approximately 50 students from several classes at SUNY Cortland.

The risks associated with your participation in this study are very minimal. However, it is possible that you may experience some delayed onset muscle soreness (DOMS) following each of the three days of the intervention for this study. If this does occur, it will likely be minor and short term.

Only the researcher and his thesis committee members will have access to your videotaped performances. Your videotaped performances will be saved in a windows folder containing the last 4 digits of your ID #, and the day/time of your testing. Additional information about the types of feedback you chose, or the types of feedback you were provided with will be stored on paper files. All information will be kept confidential. The videos will be deleted at the completion of the study. All other data will be stored in a locked cabinet for no more than three years. At no time will your name be associated with the data results. Only group aggregate scores will be reported.

You are free to withdraw consent at any time without penalty. Additionally, at any time, you may ask the researcher to destroy all videotape recordings of your performances, as well as any other data or information collected.

From participating in this study you should expect to come to a better understanding of the way in which research is conducted. You will have the opportunity to learn the proper form for the squat. Upon completion of participation, you can earn extra credit if it was agreed upon by the professor of the class from which you were recruited.

If you have any questions concerning the purpose or results of this study, you may contact Josh Davis at (716) 860-9166 or at davis10000@gmail.com. Other contacts include: Dr. Joy Hendrick, Professor of Kinesiology at Studio West, room 152, Phone: (607) 753-5707, or joy.hendrick@cortland.edu. For questions about research at SUNY Cortland or questions/concerns about participant rights and welfare, you may contact Leslie Eaton, IRB Administrator, PO Box 2000, Cortland, NY 13045 (phone (607) 753-2079 or email: irb@cortland.edu,). In the event of an injury please contact the SUNY Cortland Counseling Center in room B-44 in Van Hoesen Hall at (607) 753-4728, and/or SUNY Cortland Health Center in room B-26 of Van Hoesen Hall at (607) 753-4811.

I (Print Name)**_____ have read the description of the project for which this consent is requested. I understand my rights, and hereby consent to participate in this study.**

Signature:_____ Date:_____

This form was approved by the SUNY Cortland IRB on 03-27-2009 and is in effect until 03-26-2010.

Appendix N

Pre-Experimental Statement

During the course of this study, your goal will be to learn the proper form for the squat. At various points within the study, you will be required to watch a video of an expert model as she performs the squat. This video is designed to help you understand what the proper form for the squat looks like. At other points, your squatting performance will be assessed.

Most of your time during the course of this study will be spent practicing the squat. Following various practice trials, you will be provided with feedback, which is designed to help you correct your errors. Feedback will be given from the feedback list. (At this point the researcher will point out the feedback list.) Notice how the feedback list has 10 components general statements, some of which are followed by specific statements.

Additionally, you may refer to the corrective feedback list, the pictures of the video model which illustrate proper form, and the feedback list at any time during the course of this study. (At this point, the researcher will point these out.) These may be especially valuable to you following the provision of feedback after various trials. Notice how the corrective feedback list contains suggestions for correcting errors.

A typical day will start with a test consisting of 5 trials with no feedback provided, and preliminary viewings of a video model as various components of the squat are pointed out. Next, instructions will be read, after which practice will ensue, with feedback provided following various trials. Lastly, another test may or may not be administered, and the day will be concluded with stretching.

Appendix O

Post-Study Questions

The following are questions that participants from the two groups were asked to write answers to at the end of the study. First, a series of questions which were provided for the self-control group are listed. Next, a series of questions which were provided for the yoked group are listed. When these questions were provided for participants each group, each series of questions was spread out across a complete page as to provide ample space to answer the questions.

Questions for Participants in the Self-Control Group

During this study you were likely provided with video feedback and verbal feedback. Which one was more time consuming?

Did you ever choose one type of feedback over another because you thought it would take less time?

Which type of feedback do you feel was most effective?
Why do you think this type of feedback was most effective?

Why did you choose video feedback when you chose it?

Why did you choose verbal feedback when you chose it?

Questions for Participants in the Yoked Group

Was there ever a time when you were provided with one type of feedback, but you would have preferred to receive the other type? Please Explain

Do you feel it would have been better if you were given the choice as to whether you would receive video or verbal feedback instead of always being told which type of feedback you would receive?
Why?

During this study you were likely provided with video feedback and verbal feedback. Which one was more time consuming?

Which type of feedback do you feel was most effective?
Why do you think this type of feedback was most effective?

Appendix P

Post-Study Questions with Answers

Following are the questions which were answered by participants in this study after the completion of data collection. In the left column, questions are listed followed by the paraphrased answers to those questions. Listed in the right column, next to each response, are the number of participants who gave each particular response.

Questions Answered by the Self-Control Group

Queston: During this study you were likely provided with video feedback and verbal feedback. Which one was more time consuming?	
Verbal feedback was more time consuming.	0
Video feedback was more time consuming.	12

Question: Did you ever choose one type of feedback over another because you thought it would take less time?	
Yes	5
No	7

Question: Which type of feedback do you feel was most effective?	
Video feedback was most effective.	8
Verbal feedback was most effective.	4

Question: Why do you think this type of feedback was most effective? (answers from those who thought video feedback was most effective)	
It allowed me to see what I was doing wrong.	3
Seeing my mistakes helped me realize how I could correct them.	2
It let me analyze my error, and look at the elements of the squat that caused it.	1
I could see what I was doing wrong, and to what degree I was making the error.	1
I am a visual learner.	1

Question: Why do you think this type of feedback was most effective? (answers from those who thought verbal feedback was most effective)	
I learn better from hearing things than seeing them.	1
I didn't like watching myself on video, and I prefer to hear instructions verbally.	1
When I received verbal feedback, I could vidualize my mistake and fix it. I wasn't distracted by everything else on the video.	1
I preferred verbal feedback bacause it allowed me to think about and picture what I was doing wrong.	1

Question: Why did you choose video feedback when you chose it?	
Seeing my mistakes helped me to correct them.	3
I wanted to change things up.	2
To see what I looked like, and/or to see whether video or verbal feedback was better.	2
I chose video to see how my squat was progressing.	1
I felt it would help every so often.	1
So I could see how I was performing, and how to correct my mistakes.	1
If I made a particiular mistake repeatedly, I chose video to get a better idea of what I was doing wrong.	1
At times, I thought I performed the squat correctly, and I wanted to see what I did for myself.	1

Question: Why did you choose verbal feedback when you chose it?	
I liked it more and/or got more out of it.	3
I knew what I did wrong, and I didn't need to see it.	2
I chose verbal feedback when I thought I had performed the squat correctly because it was quicker.	1
Verbal feedback allowed me to focus more on the particular error that was pointed out.	1
It was quicker, and I preferred to hear rather than to see what I was doing wrong.	1
To get a better idea as to what I was doing wrong.	1
To see if it would be more helpful than video feedback.	1
I only chose it once, because I felt it was less effective than video feedback.	1
I didn't want to look at myself.	1

Questions Answered by the Yoked Group

Question: Was there ever a time when you were provided with one type of feedback, but you would have preferred to receive the other type? Please Explain. (answers from those who weren't always happy with the type of feedback they received)	
I received verbal feedback too many times in a row.	1
I received video feedback too many times in a row.	1
I would have preferred to see myself. This would have aided me in error correction.	1
At times, I would have preferred to receive video feedback when I was given verbal feedback.	1
Sometimes when I made mistakes, I would have preferred to receive video feedback, but I received verbal feedback instead.	1
There were times when I would have preferred one type of feedback over another depending on my performance.	1

Question: Was there ever a time when you were provided with one type of feedback, but you would have preferred to receive the other type? Please Explain. (answers from those who were happy with the type of feedback they received)	
I liked the feedback choices my counterpart made.	1
I received a mixture of both types of feedback. It worked well.	1
Regardless of which type of feedback I received, it pertained the the particular error I was making.	1
Both types of feedback provided me with similar information.	1
I received video feedback every time except for the first time. I preferred it this way.	1
I preferred verbal feedback, and that is what I tended to receive.	1

Question: Do you feel it would have been better if you were given the choice as to whether you would receive video or verbal feedback instead of always being told which type of feedback you would receive? Why? (answers from those who said it would have been better if they had been given a choice)	
There were times when I kept making the same error and I wanted to receive video feedback, but couldn't.	1
Video feedback would have been more beneficial at times, while at other times, verbal feedback would have.	1
Sometimes, when I knew what I did wrong, I would have preferred to receive video feedback, but I received verbal feedback instead.	1
I preferred to see myself on the projector.	1
I received too much verbal feedback. At times, I would have preferred to receive video feedback.	1
Video feedback gave me the same information as verbal feedback, and it allowed me to see my mistakes.	1
At times, seeing myself would have better helped me to correct my errors.	1

Question: Do you feel it would have been better if you were given the choice as to whether you would receive video or verbal feedback instead of always being told which type of feedback you would receive? Why? (answers from those who said it would not have been better if they had been given a choice)	
Both methods provided me with feedback which helped me to improve.	1
I probably would have always requested verbal feedback, but because I was forced to receive both types of feedback, I benefited as a result.	1
I preferred verbal feedback because it was quicker, and the bar was heavy. (That is what I tended to receive.)	1

Question: Do you feel it would have been better if you were given the choice as to whether you would receive video or verbal feedback instead of always being told which type of feedback you would receive? Why? (answers from those who gave neutral responses)	
I only received verbal feedback once. I preferred it this way, but if it had been the other way around, things might have worked out differently.	1
At times I would have preferred to receive video feedback, but both types were fine.	1

Question: During this study you were likely provided with video feedback and verbal feedback. Which one was more time consuming?	
Video feedback was more time consuming.	12
Verbal feedback was more time consuming.	0

Question: Which type of feedback do you feel was most effective?	
Video feedback was most effective.	10
Verbal feedback was most effective.	2

Question: Why do you think this type of feedback was most effective? (for those who felt video feedback was most effective)	
I could visually see what I was doing (wrong).	6
I saw my mistakes instead of having to mentally visualize them.	2
I learn better visually.	1
I could see what I was doing wrong, and I learn better visually.	1

Question: Why do you think this type of feedback was most effective? (for those who felt verbal feedback was most effective)	
Verbal feedback is specific and to the point.	1
Verbal feedback pinpointed my mistakes.	1