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The Effects of Self-Control Video Feedback on the Basketball Set Shot

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To the Graduate Council:

I am submitting herewith a thesis written by Christopher Adam Aiken entitled "The Effects of Self-Control Video Feedback on the Basketball Set Shot." I have examined the final electronic copy of this thesis for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Master of Science, with a major in Kinesiology.

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The Effects of Self-Controlled Video Feedback on the Basketball Set Shot

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ABSTRACT

The purpose of the current study was to examine the effects of self-controlled video feedback on the learning of the basketball set shot. Female participants were assigned to self-control (SC) (n = 14) and yoked (YK) (n = 14) groups. SC participants were allowed to request video feedback in the form of knowledge of performance (KP) following any trial while YK participants received video KP according to the schedule created by their SC counterpart. Participants in both groups were also allowed to view a poster of written instructional cues at any time. An acquisition phase consisted of 25 set shots (five blocks) from a youth free throw line (3.66 m). Each trial was 30 s in duration. An additional 30 s break was given between blocks. Retention and transfer phases each consisted of ten trials (two blocks) and occurred 24 hours following acquisition. Retention was administered from the youth free throw line and transfer from a traditional free throw line (4.57 m). Participants were scored on both movement form and shooting accuracy during acquisition, retention, and transfer. Results indicated that the SC group had significantly higher form scores than the YK group during Blocks 3 and 5 of acquisition and during the transfer phase. In addition, the SC group looked at the instructional cues more frequently than the YK group. Both groups increased shooting accuracy during acquisition ($p < .05$), but did not differ from one another during any of the experimental phases. A number of results differed from previous research findings. The responses of participants on a post-training questionnaire indicated no preference for requesting or receiving feedback following so-called *good* trials as reported by Chiviacowsky & Wulf (2002, 2005). In addition, there were no differences in accuracy or form between feedback (i.e., *good*) and no feedback (i.e., *poor*) trials. Overall, the results indicated that self-controlled video KP facilitated learning of correct shooting technique.

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CHAPTER 1

Introduction

Recent research in motor learning has demonstrated the potential benefits of allowing a learner to control some aspect of an instructional protocol compared to conditions in which the entire protocol is prescribed by the researcher (for a review, see Wulf, 2007). Self-control manipulations have been shown to facilitate learning for a variety of tasks, including those that require sequence learning (Chen, Hendrick, & Lidor, 2002; Chiviacowsky & Wulf, 2002, 2005, 2007; Patterson & Carter, 2010) and object projection (Chiviacowsky, Wulf, Medeiros, Kaefer, & Tani, 2008; Janelle, Barba, Frehlich, Tennant, & Cauraugh, 1997; Janelle, Kim, & Singer, 1995; Kolovelonis, Goudas, & Dermitzaki, 2009). Self-control manipulations have included physical guidance (Wulf, Clauss, Shea, & Whitacre, 2001; Wulf & Toole, 1999), amount of practice (Post, Fairbrother, & Barros, in press), task scheduling (Keetch & Lee, 2007), video demonstration (Wrisberg & Pein, 2002; Wulf, Raupach, & Pfeiffer, 2005), and augmented feedback (Chiviacowsky et al., 2008; Janelle et al., 1995). The largest portion of these studies has included examinations of the effects of self-controlled feedback in the form of knowledge of results (KR) or knowledge of performance (KP).

Several explanations have been forwarded to account for self-control benefits seen in motor learning research. Janelle and colleagues (Janelle et al., 1995, 1997) suggest that self-control allows a learner to process information on a deeper cognitive level. McNevin, Wulf, & Carlson (2000) argued that self-control might increase participant motivation, presumably to engage in deeper task-related information processing that would facilitate learning. Chiviacowsky and Wulf (2002) noted that participants use self-control to strategically tailor their experience to fit their needs and preferences. This latter argument was based on findings that participants reported asking for feedback after so-called *good* trials and that performance was superior on those trials compared to no-feedback (i.e., *poor*) trials.

Another interesting aspect of self-control research is that learners have typically requested instructional assistance (e.g., feedback, video demonstration, or guidance) less frequently than might be expected. For example, Wulf, Raupach, and Pfeiffer, (2005) found that self-control participants requested video demonstration of a basketball jump shot on only 5.8% of acquisition trials. Similarly, Janelle et al. (1995) found that self-control participants requested KR on an underhanded tossing task after approximately 7% of acquisition trials. It has also been reported that self-control participants decrease requests for instructional support as practice progresses. For example, Chiviacowsky and Wulf (2002) found that KR requests were made after 44.7% of trials during the first block of acquisition but after only 28% during the sixth block. These findings provide were consistent with the idea that self-control prompts deeper engagement in cognitive processes related to decisions about when instructional support is needed and how this support can be strategically used to facilitate learning.

As noted previously, the most frequent self-control manipulations have involved various types of augmented feedback, usually in the form of KR (e.g. Chiviacowsky et al., 2008; Chiviacowsky & Wulf, 2002). Self-controlled KR has been shown to benefit learning when compared to groups that received feedback on 100%, 50%, or 20% of trials, or were yoked to the feedback schedules created by self-control participants (Chiviacowsky & Wulf, 2002; Janelle et al., 1995). The one study that used self-controlled KP provided it in conjunction with verbal KP and showed that the combination facilitated learning compared to a yoked group, a 50% KP group, and a 20% KP group (Janelle et al., 1997). Typically a self-controlled feedback group is tested against a yoked group to control for a potential confound introduced by the effects of reduced frequency of feedback, which has been shown to enhance learning (Winstein & Schmidt, 1990). Although self-controlled feedback has been found to be effective for learning a variety of tasks, its use warrants further examination for a number of reasons. One of these reasons relates to the delivery of KP using video replay. Early research involving the use of video KP demonstrated that it facilitated the learning of complex skills (Baker, 1970; Guadagnoli, Holcomb, & Davis, 2002; Hazen, Johnstone, Martin, & Srikameswaran, 1990; Rikli & Smith, 1980; Rothstein & Arnold, 1976; Van Wieringen, Emmen, Bootsma, Hoogesteger, & Whiting, 1989). In the self-control literature, video KP in conjunction with verbal KP has also been shown to facilitate learning compared to a yoked control condition (Janelle et al., 1997). It is still unknown, however, if video KP administered without additional verbal KP is an effective mode of feedback delivery within a self-control protocol.

On the one hand, it seems reasonable to assume that the use of self-controlled video KP would facilitate learning because of the previous demonstrations of self-control benefits across a broad range of tasks and types of instructional support. On the other hand, some video KP research has suggested that video may provide novice learners with too much information, thereby reducing its instructional effectiveness (Emmen, Wesseling, Bootsma, Whiting, & Van Wieringen, 1985; Rothstein & Arnold, 1976). Because video KP conveys information about multiple aspects of performance, novice learners might not know how to effectively identify the most salient pieces of information to benefit learning. Rothstein and Arnold (1976) noted that the provision of attentional cues along with video might assist learners in effectively directing their attention to critical information in the video. Even with the addition of attentional cues, however, video KP still conveys much more information than traditional forms of feedback that typically deal with a single aspect of performance (e.g., algebraic error in meeting a time goal), which has some potentially important implications regarding reported preferences for feedback following so-called *good* trials (e.g., Chiviacowsky & Wulf, 2002).

The findings regarding the benefits of feedback after *good* trials (Chiviacowsky & Wulf, 2007) and self-control participants' preferences for feedback after such trials (Chiviacowsky & Wulf, 2002) has been based on experiments that used relatively simple laboratory-based sequential timing tasks and provided feedback on a single aspect of performance. When examining a more complex skill such as a basketball set-shot, one aspect of the motion might be considered *good* (e.g., correct follow-through) while another aspect might be *poor* (e.g., incorrect motion at the knee). Accordingly, categorization of any given trial as either *good* or *poor* will likely be problematic and self –control participants might find themselves in a dilemma with respect to their decisions about when to request or how to successfully use video KP. This dilemma might be remedied with the assistance of an experienced instructor (Janelle et al., 1997), but such support might not always be readily available. Consequently, it is important to determine if self-controlled video KP alone can facilitate motor skill learning.

Statement of problem

The purpose of the present study was to examine the effects of self-controlled video KP on the learning of the basketball set-shot.

Research hypotheses

Based on the self-control literature in motor learning, the following hypotheses were forwarded:

1. The self-controlled video KP group would achieve higher form scores during retention and transfer testing compared to the yoked control group.

2. The self-controlled video KP group would display a decreasing frequency of feedback requests as the acquisition phase progressed.
3. For the self-controlled video KP group, form scores would be higher on feedback (*good*) trials than on no-feedback (*poor*) trials.
4. The self-controlled video KP group would report that they asked for feedback after *good* trials more frequently than after *poor* trials.
5. The yoked control group would report a preference for receiving feedback after *good* trials compared to *poor* trials.

Delimitations

This study was delimited in the following ways:

1. Participants were 28 women from the Knoxville, Tennessee area.
2. Participants had no organized basketball experience past the 8^{th} grade.
3. Participants ages ranged from 20 to 41 years (M = 26.43 ± 5.23)

Assumptions

This study was based upon the following assumption:

1. All participants were motivated to perform the task according to instructions and to the best of their abilities.
2. All of the participants were honest about their previous experience with organized basketball.
3. Participants followed instructions and did not practice the task in any way between the acquisition phase and retention and transfer phases.

Definition of terms

The following definitions were used in this study:

Absolute error (AE). The absolute difference between the goal for a trial and the actual performance on the trial.

Acquisition. The time period during which the learner first acquires the designated motor skill. The acquisition phase is also referred to as the practice phase in motor learning studies.

Attentional focus. The direction of one's attention to specific characteristics of a movement or a specific environmental cue.

Augmented feedback. An external form of feedback that is given to a learner in addition to the person's own sensory feedback. Augmented feedback is usually given when the learner needs additional information in order to learn the task.

Avery Richardson Tennis Service Test (ARTST). The ARTST is a standardized test used to determine how well a tennis serve is performed. The test consists of 20 services, five from 4 separate locations, which must be hit into 4 separate areas. The test also takes in consideration ball velocity, accuracy, and slice.

Block (see also Trial block).

Complex skill. A task involving multiple-degrees-of-freedom movements and generally taking more than one session of acquisition to learn. An example would be an overhand throw, the basketball shot, or performance on a ski simulator. Defining complexity is difficult because a given task may be challenging to one learner and not another (Wulf & Shea, 2002).

Control group. A group of subjects that is similar demographically to the experimental group, however they do not receive the experimental intervention.

Degrees-of-freedom. Degrees-of-freedom refer to the number of planes of motion used in a given movement pattern or skill (Kernodle & Carlton, 2001).

Knowledge of performance (KP). Augmented feedback related to the nature of the movement produced (Schmidt & Lee, 2005, p. 465).

Knowledge of results (KR). Augmented feedback related to the nature of the result produced in terms of the environmental goal (Schmidt & Lee, 2005, p. 465).

Motor learning. Changes in internal processes that occur as a result of practice or experience performing a motor task.

Motor performance. The execution of a motor task.

Motor skill. A skill that requires limb or body movement to perform a task or achieve a goal.

Movement time. The total amount of time from the initiation of movement to the completion of that movement.

Novice. A person having little or no experience with a given task or movement pattern.

Observational learning. The theory that states a person can learn a skill or behavior by watching another person perform the same or related task.

Reduced frequency of feedback effects. Fading the amount of KR presentations has been found to greatly improve learning (Winstein & Schmidt, 1990). Reduced frequency involves providing a learner with more frequent KR during the initial stages of practice and gradually declining the amount of KR throughout acquisition. This in turn will facilitate in greater learning.

Relative timing. The notion that the ratios of time that occur during specific phases of a movement remain the same when the speed of the movement is adjusted.

Retention. The persistence of performance following a period of no practice. Retention tests are administered after an acquisition phase in order to determine the degree to which the participant retained the practiced skill. Retention tests are usually given 24 hours following acquisition and consist of performance on the same task practiced during acquisition.

Self-control group. An experimental group consisting of participants that are allowed to control some aspect of the learning environment. Typically in motor learning studies, self-control is manipulated by allowing participants to control the frequency with which they receive KR or KP.

Ski simulator. An apparatus that allows the simulation of skiing movements. Participants perform lower body movements from left to right and right to left over a slight elevation, similar to what a skier would experience during carving. The simulator measures the amplitude between movements to determine how far the participant moved.

Social reinforcement. The provision of various phrases verbalized to encourage participants about their performance.

Transfer. The degree to which performance on one task during acquisition influences performance on another task following acquisition. In order to assess the transfer of a learned skill, transfer tests are administered that incorporate slight variations to the task used during acquisition.

Trial block. A group of trials that are statistically analyzed together. Typically, following the group of trials a resting break is given to the participant before the next group of trials.

Yoked group. A control group comprised of individuals that receive feedback on the same schedule as their respective self-controlled counterparts.

CHAPTER 2

Review of Literature

The purpose of this chapter is to provide a review of previous research dealing with the issues of self-control of feedback and video feedback. Discussion will center on how self-controlled feedback has been examined in motor learning studies as well as some of the possible explanations for its effectiveness. In addition, some discussion will be devoted to how the use of knowledge of performance (KP) in the form of video replay might facilitate learning. Finally, these two areas of literature will be considered together with respect to their implications for an examination of the efficacy of self-controlled video KP in teaching a motor skill.

Self-controlled feedback

The use of feedback to facilitate learning has been well documented in the motor learning literature. Early research indicated that learning was enhanced by the provision of knowledge of results (KR). It was also believed that there was no learning in the absence of KR (Bilodeau, 1956). Subsequent research revealed, however, that allowing a participant to receive a 100% frequency of KR (i.e., after every trial) facilitated performance in acquisition while degrading learning (as indicated by retention testing) compared to conditions that received KR less frequently (for a review, see Salmoni, Schmidt, & Walter, 1984). It was reasoned that less frequent feedback benefits the long-term effects of motor learning because it encourages more problem solving by the learner and discourages a dependency on augmented feedback. In the 1990s, research on self-regulation effects also began to show that providing a learner the opportunity to control some aspect of an experimental protocol (i.e., self-control) facilitated learning of both simple and complex motor tasks (Janelle, Kim, & Singer, 1995; Janelle, Barba, Frehlich, Tennant, & Cauraugh, 1997). The most common way self-control manipulations have been examined is by allowing learners the opportunity to determine when they receive augmented feedback during practice. Generally, performance of the self-controlled feedback condition is then compared to that of a yoked condition during acquisition, retention, and transfer phases. Each yoked participant is tethered to a self-control participant and receives feedback on the same schedule as this counterpart to match the relative feedback frequency across the conditions. Self-controlled feedback has been examined with a variety of tasks, including overhand throws (Janelle et al., 1997), underhanded tosses (Chiviacowsky, Wulf, Medeiros, Kaefer, & Tani, 2008), and sequential key pressing (Chiviacowsky & Wulf, 2002). The first published study to examine the effects that self-controlled feedback on motor learning was designed to determine if a self-controlled KR condition would facilitate learning compared to other more traditional schedules of administering feedback (Janelle et al., 1995). Five experimental conditions with various KR frequencies were examined, including a SC group and a yoked group. Participants learned to toss a golf ball underhanded with the non-preferred hand so that it hit as close as possible to the center of a circular target on the ground. KR was provided in the form of the distance and direction from the target center to the location the ball landed. Acquisition consisted of 40 trials followed by a 20-trial no-KR retention test 10 minutes later. Results for absolute error (AE) indicated that during retention the SC group significantly outperformed all other groups, thereby illustrating that motor learning could be facilitated by allowing a learner to determine KR frequency.

Whereas the majority of the self-controlled feedback studies have examined KR, one study has investigated the effects of self-controlled KP on motor learning using video replay in conjunction with verbal statements (Janelle et al., 1997). The task required participants to throw a tennis ball overhand with the non-preferred arm and feedback was given in the form of KR, summary KP, self-controlled video KP, or yoked video KP. The KR group received no augmented feedback, but was able to view where the ball landed relative to the target on each throw. The summary KP group received feedback after every five trials. The feedback consisted of an instructor pointing out the most critical flaw in throwing form accompanied by video KP of the last two trials of the block. The self-controlled KP group received feedback when requested. Results indicated that groups that received KP significantly outperformed the KR group for throwing form during acquisition using a form rating scale. In retention, the self-control video KP group outperformed all other groups for both throwing form and accuracy. Although this study showed that the benefits of self-controlled feedback extended from KR to KP, it is important to note that the SC group received both video KP and verbal KP from an instructor directing attention to the most problematic aspect of the movement. It is currently unknown if this benefit would be seen in a protocol using only video KP.

As an extension Janelle and colleague's (1995, 1997) work, Chen, Hendrick, and Lidor (2002) examined whether the benefits of self-controlled KR were influenced by the degree of autonomy provided to the learner in implementing self-control decisions. In one condition, participants were told at the outset of the experiment that they would receive feedback only when requested. In another condition, participants were prompted by the experimenter after each trial regarding their feedback decision. Each group was also coupled with a corresponding yoked group. The task required participants to learn a specific key-press sequence to match a criterion time. Results in constant error (CE) indicated that both of the SC groups performed more accurately than their yoked counterparts during both immediate and delayed retention testing. This study demonstrated that reducing learner autonomy by prompting self-control decisions did not affect the learning benefit of self-controlled KR compared to yoked conditions, which indicated that an instructor could encourage self-regulation without compromising its effects.

The benefits of self-controlled feedback have been explained as the result of deeper cognitive processing and increased learner motivation (Janelle et al., 1995, 1997). In addition, researchers examining the benefits of self-control of a physical guidance manipulation (i.e., the use of ski poles) in a balancing task argued that it encouraged participants to try various solution strategies (Wulf & Toole, 1999). Chiviacowsky and Wulf (2002) noted that the self-controlled feedback benefit might also stem from the fact that this manipulation allowed learners to tailor their use of instructional support to individual needs or preferences. To explore this possibility, they compared SC and yoked feedback groups on the performance and learning of a sequential timing task and implemented a post-training questionnaire designed to determine when and why self-control participants requested feedback. Results indicated that the SC group was more accurate than the yoked group during a transfer test requiring a novel timing goal. The questionnaire results revealed that SC participants reported asking for feedback mostly following so-called *good* trials (i.e., more accurate trials) while YK participants reported they would have preferred feedback following *good* trials if given the choice. Subsequent analysis of feedback (i.e., *good*) trials versus no-feedback (i.e., *poor*) trials showed that feedback trials were performed more accurately, thereby supporting the notion that self-control participants requested feedback to confirm their accuracy rather than to correct mistakes. It also revealed that learners are capable of self-evaluating performance in order to make decisions about feedback requests.

Chiviacowsky and Wulf conducted two follow-up studies to further examine the role of self-evaluation in self-controlled feedback benefits and the use of feedback to confirm *good* performance as opposed to correcting *poor* performance. In one of these (Chiviacowsky &

Wulf, 2005), they showed that having participants make self-controlled feedback decisions after a trial facilitated motor learning compared to when they made such decisions before a trial. This finding was interpreted as supporting the idea that self-evaluation is an important aspect of self-control effects. It should be noted, however, that no yoked conditions were included so it was not possible to examine different levels of self-controlled feedback effects, per se. In the other study (Chiviacowsky & Wulf, 2007), the effect of providing KR for the three most accurate trials in a six-trial block (i.e., *good* trials) was compared to that of providing KR for the three least accurate trials (i.e., the *poor* trials). Results indicated that KR for *good* trials facilitated learning compared to KR for *poor* trials. Chiviacowsky and Wulf interpreted the results of their three studies as indicating a serious shortcoming in the traditional view of KR as functioning primarily to provide corrective information and suggested that the motivational function of augmented feedback might be more important than previously believed.

Interestingly, in a study designed to examine the effects of self-controlled KR in a multiple task learning situation, Patterson and Carter (2010) reported that although both SC and yoked groups stated a preference for feedback after *good* trials, there was were no significant difference in timing accuracy between feedback and no-feedback trials. This finding suggests that a participant's self-evaluation capabilities might degrade as the complexity of a learning situation increases. If true, then learning complex tasks might produce a mismatch between a learner's motives for requesting feedback after a *good* trial and the capability to actually determine when such a trial occurs. In some cases, this might undermine the benefits of self-controlled feedback if feedback is requested after what was actually a fairly *poor* trial. In other cases, it might simply indicate that the experimenter's criterion for a *good* trial does not adequately represent a variety of aspects that the learner might be using to self-evaluate. The potential for this latter case would presumably be fairly high when administering video KP that includes information about several aspects of a movement technique. To date, the only study to examine self-controlled video KP for a relatively complex task (Janelle et al., 1997) did not assess reasons for requesting feedback and so it is unknown if participants asked for KP following what they considered to be *good* trials.

Based on the existing evidence, further investigation of self-controlled video KP is warranted. Although it has been shown that video KP can facilitate motor learning in a self-control protocol when provided in conjunction with verbal KP, it is unknown if it can do so alone. The fact that KP is typically used when teaching relatively complex tasks and that video replay provides a relatively large amount of information compared to traditional forms of KR raises the possibility that self-controlled feedback might not be as effective when using video replay as the only source of KP. The next section provides a review of relevant video feedback literature that has potential bearing on the use of self-controlled video KP.

Video feedback

KP can be used to describe movements of the whole body and is often necessary to learn complex skills such as a basketball jump shot. The use of a video replay can be an attractive method of providing KP and has been a common method of delivering such feedback in research since the 1960s (for a review, see Rothstein & Arnold, 1976). Interestingly, the large amount of research on the usefulness of video replay as a feedback modality has not been unequivocal in demonstrating its effectiveness (Salmoni et al. 1984). For example some studies have shown that video KP facilitates the learning of motor skills (Cooper & Rothstein, 1981; Guadagnoli, Holcomb, & Davis, 2002; Hazen, Johnstone, Martin, & Srikameswaran, 1990; Van Wieringen, Emmen, Bootsma, Hoogesteger, & Whiting, 1988) while others have shown little to no benefit compared to physical practice alone without the aid of video KP (Emmen, Wesseling, Bootsma, Whiting, & Van Wieringen, 1985; Kernodle, Johnson, & Arnold, 2001; Rikli & Smith, 1980).

Rothstein and Arnold (1976) reviewed 52 studies that utilized video KP as an experimental manipulation and found that 33 showed no significant differences between a video KP group and a control group. The other 19 studies showed a significant benefit for the use of video KP. The successful video KP studies were then further examined to identify factors that might have contributed to the successful use of video replay. The findings yielded several suggestions regarding the effective use of video KP. For example, it was recommended that video KP be supported with the use of verbal cues to direct attention, frequent administration of video replay, practice immediately following replay, and video that appropriately focused on the aspect of movement under consideration.

Van Wieringen et al. (1989) examined the effects of video KP when teaching a tennis serve to intermediate-level players by implementing the suggestions that video be used for five weeks and to use verbal cues to direct the learner's attention while using video KP. Based on a pre-experiment assessment of their serving skill using the ARTST, participants were assigned to one of three conditions: a traditional training group (physical practice with video model demonstration), a video training group (physical practice with video KP), or a control group (physical practice only). Participants trained in the prescribed method for 40 minutes twice a week and were tested following a five week training regimen. Results indicated that both the traditional video training groups significantly outperformed the control group in terms of both effectiveness and form during post-testing. No significant differences were found between the traditional training and video training conditions, however, the video training group did significantly outperform the control group. These results indicated that receiving video KP can facilitate learning with intermediate tennis players but no more than traditional training techniques.

Rothstein and Arnold's (1976) recommendation to supplement video KP with verbal cues was examined by Kernodle and Carlton (1992). Participants were assigned to one of four conditions: KR, video KP, video KP with verbal cues, and video KP with transition statements about what to aspect of form to correct on the next trial. The task was to throw a 30 g foam ball as far and as straight as possible. After four weeks of training, results indicated that all groups improved in terms of throwing distance, with the transitional statement video KP group performing significantly better than the KR and video KP groups. Form ratings revealed that the transitional statement video KP group and the KP with verbal cues group performed with significantly better form than the video KP and KR groups. These results indicated that video KP in conjunction with transitional statements or verbal cues is more effective in teaching an overhand throw than KR or video KP alone. Presumably, the transitional statements and verbal cues helped the participants attend to the most relevant information in the video and not become overwhelmed with too much information.

Despite the mixed evidence for the effectiveness of video KP in general, it remains a common teaching tool for skill instruction in sport. For example, video instruction is quickly becoming a normative training method for many recreational and professional golfers (Guadagnoli et al., 2002). Accordingly, Guadagnoli et al., (2002) looked at the possible usefulness of video KP on training the golf swing. One common issue that arises with the use of video KP is whether the cost of lost physical practice time due to viewing video outweighs traditional the benefit. Although Van Wieringen et al. (1989) showed that for intermediate tennis players the trade-off between the benefits of physical practice and video viewing was not significant, further examination of the issue was warranted. The purpose of the Guadagnoli et al.'s (2002) study was to examine the short and long term effects of video KP compared to more traditional training methods on a 200 yd 7-iron shot. Golfers with relatively low handicaps were randomly assigned to one of three conditions: traditional training, video training, and a control group. After four 90-minute training sessions, retention test were administered at delays of 48 hours and two weeks. Results from the second retention test showed that the video KP group significantly outperformed the traditional training group in terms of both accuracy and form. Both instructional groups outperformed the control group. This study illustrated that video KP can have beneficial long-term effects despite showing no immediate benefits compared to traditional training.

As indicated by this brief review of video KP research, the implementation of effective video KP is not always a straightforward endeavor. The studies that incorporated more than one of Rothstein and Arnold's (1976) suggestions generally showed a benefit from using video KP. Providing instructional cues or transitional statements may be one of the most important suggestions in the literature because it allows a learner to break down complex movements to benefit more fully from video KP.

Considerations for using video KP in a self-controlled feedback protocol

Based on the findings in both the self-controlled and the video feedback literature, there are several issues to consider when implementing a self-control video KP protocol. One of these considerations is the amount of feedback that should be provided to the learner. Early video KP literature suggested that learners require the aid of video feedback frequently because of the amount of information provided. However, the self-control literature has shown that learners don't require as much feedback as one would expect to learn a complex movement. The early work by Janelle et al. (1997) found that self-control participants requested KP feedback on only 11.2% of the trials throughout acquisition. They requested feedback on 20.8% of trials during the first block of acquisition and decreased requests to 6.7% on the last block of acquisition. In Janelle et al. (1995), KR feedback requests were reported as occurring on only 7% of acquisition trials. Similarly, Chiviacowsky and Wulf (2002) found that participants requested KR on 35% of trials, ranging from 44.7% on Block 1 to 28% on Block 6. In general, the findings from self-controlled feedback research have shown that learners request a relatively low amount of augmented feedback and tend to decrease requests as practice progresses. Such low feedback request frequencies differ substantially from the recommendations in the video KP literature. The current study helped to resolve this discrepancy by determining if self-controlled video KP facilitated learning for a group that selected their own feedback frequency.

Another consideration relates to previous reports that self-control participants have typically requested feedback following so-called *good* trials (Chiviacowsky & Wulf, 2002). This finding suggested that self-control participants were capable of evaluating their own performance based on inherent feedback. If this observation is generalizable to other feedback modalities, it would be expected that participants in the self-controlled video KP group of the current study would also request feedback after the trials they perceive to be *good*. However, the complexity of the movement pattern required by the set-shot combined with the emphasis on learning correct form might allow participants to feel that one aspect of their form is *good* while another is *poor*. In such cases, participants might have difficulty in categorically identifying a trial as either *good* or *poor*. In addition, when learning a complex movement participants might shift attention from one aspect of form to another on different trials and seek either corrective feedback for aspects that were performed poorly or confirmatory feedback for aspects that were performed well. The questionnaire used in the current study explored some of these possibilities by allowing participants to indicate the frequency with which feedback requests were made after both *good* and *poor* trials rather than just indicate if feedback was requested “mostly” after one trial type or another. In addition, the open-ended items provided the opportunity to elaborate on the reasons why feedback was either requested or not.

Taken together, the previous literature on self-controlled feedback and video KP indicates a need to directly examine the efficacy of self-controlled video KP for learning a motor skill. The logical expectation that video KP would work as well as any of the previous self-controlled feedback manipulations is tenuous when one considers issues related to the amount of information presented by video replay and that fact that KP is often reserved for complex tasks that require a learner to consider many different aspects of movement form. Janelle et al. (1997) established that self-controlled video KP *in combination with* verbal KP can facilitate the learning of a complex skill. The purpose of the current study was to extend this line of research by determining if self-controlled video KP *alone* facilitated the learning of the basketball set-shot.

CHAPTER 3

Methods

In this chapter, the methodology used in the present study is discussed. These include the participants examined, the apparatus used for data collection, the task, and the data treatment and analyses.

Participants

Participants were 28 women (26.43 ± 5.23 years of age) recruited from the city of Knoxville, Tennessee. Prior to their involvement in the study, all participants read and signed an informed consent document approved by the University of Tennessee, Knoxville Institutional Review Board (Appendix A). Participants were then assigned an identification number and asked to select a pseudonym to be used during form ratings of video clips to ensure the rater was naïve to the participants' experimental condition. Participants were randomly assigned to either a SC group (n = 14) or a YK group (n = 14). To facilitate the recruitment of novices, the sample was restricted to include only women because they generally have less experience with organized basketball compared to men. All included participants were classified as novice basketball players using the criteria that they had no formal experience with organized basketball past the 8^{th} grade. In addition, participants were naïve to the purpose of the study.

Apparatus

Figure 1 shows a diagram of the data collection area and equipment. Data was collected in a private gymnasium in Knoxville, Tennessee using a basketball court with NCAA regulation dimensions. The basket was positioned 10 ft (3.05 m) above the court and had a rim circumference of 18 in (0.46 m). Standard and youth free throw lines (City of Knoxville, Tennessee) were located 15 ft (4.57 m) and 12 ft (3.66 m) from the backboard, respectively. The set shot task was completed using a NCAA regulation woman's basketball with a circumference of 28.5 in (0.72 m) and weight of 20 ounces (0.57 kg).

A video camera (Cannon ZR 960; Cannon, USA, Inc., Lake Success, NY) attached to a tripod was positioned 4.57 m to the from the front and right side of the participant along a 45 degree angle from the participant's mid-sagittal plane. The tripod height was set to 1.3 m from the bottom of the camera to best capture the whole body movement required by the task (cf. Wulf, Raupach, and Pfeiffer, 2006). The camera was connected to a 32 in (0.81 m) LCD television (LG model 32LH200C, LG Electronics, Englewood Cliffs, NJ) located 3.05 m to the right of the participant and just in front of the youth free throw line.

A poster board (1.12 × 0.71 m) containing seven instructional cues for proper set shot form was located 3.05 m to the rear right side of the participant along a 45 degree angle from the participant's mid-sagittal plane. The experimenter was positioned at the table next to the camera to control video playback while his assistant stood between the camera and the basket to facilitate retrieving the ball.

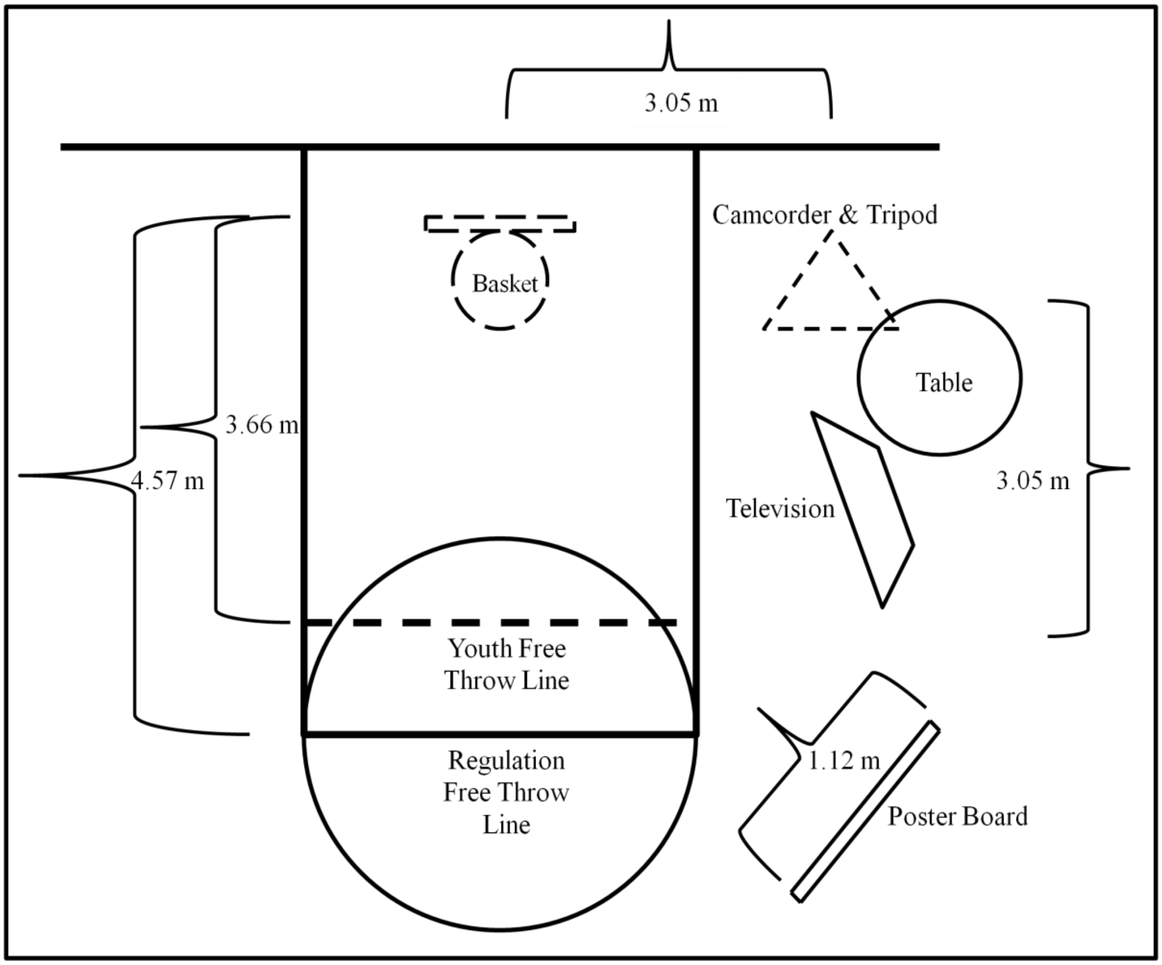

Figure 1. Diagram depicting placement of equipment during the study. (not drawn to scale).

Task

The experimental task was a set shot as used for a free throw in basketball. During acquisition and retention, participants completed the task from the youth free throw line. During transfer, the task was completed from the regulation free throw line. The task was scored on the accuracy of each shot and shooting form. The accuracy score was adapted from Wulf, Raupach, & Pfeiffer, (2005) and Cleary, Zimmerman, & Keating, (2006). Participants were awarded points based on the following criteria:

5 points – “swish” (made basket, ball never touches the rim or backboard)

4 points – made basket

3 points – ball touched the rim only

2 points – ball touched both the rim and backboard

1 point – ball touched the backboard only

0 points – “air ball” (ball missed everything)

Form scores were given to the first and last trial of each block during acquisition, retention, and transfer by a skilled rater with extensive basketball experience. The rater viewed video clips in a random order and was blind to participant identity and experimental condition and phase. The rater evaluated each video clip for the presence of seven critical features for proper set shot form (Wulf et al., 2005; Cleary et al., 2006; Amberry, 1996). For each feature, a shot was awarded a 2 if the feature was clearly recognizable, a 1 if it was somewhat recognizable, or a 0 if it was not recognizable (Wulf et al., 2005).

Procedures

Upon arriving at the data collection facility, participants were provided an approved informed consent form to read and sign. The participants then received instructions regarding the task and experimental procedures. Participants were told that they would be using video feedback to improve their basketball shooting skills and that their goal was to improve their shooting form as much as possible. In addition, they were told not to focus on shot accuracy at the expense of form. Participants then watched a brief (2 min 45 s) instructional video featuring a former NCAA division II collegiate woman’s basketball player who demonstrated proper shooting form. The video also conveyed the seven instructional features of proper set shot form. After the video, participants were informed that a list of seven instructional cues for proper set shot form would be available to them throughout acquisition on a poster board located behind them and to their right. The cues provided to participants on proper set shot form were:

Step 1: Proper form – Stand on the line with feet shoulder width apart and toes pointed towards the basket.

Step 2: Grip/Hand orientation – Place shooting hand under the ball with non shooting hand on the side for stability.

Step 3: Elbow tucked in – Keep shooting arm in towards the body.

Step 4: Bend knees – bend legs so that the knees come slightly over the toes.

Step 5: Shooting motion – rapid lift of the ball to at least the forehead height with elbow under the ball pointing towards the basket simultaneous with knee extension.

Step 6: Ball release – Release ball at or near the highest point.

Step 7: Follow through – Extend arm upward after ball release and flick the shooting hand.

Participants in the SC group were told that they would be allowed to access video feedback of their shooting form after any trial during acquisition. They were also told that they would not receive feedback unless they requested it and that they were free to watch as much as they wanted if they decided to view it. The YK group was told that they would be shown video feedback of their shooting form after some trials but not others. All participants were told that when video feedback was administered, they could watch the video as many times as they wanted (no participant watched the video for a given trial more than once). They were also told that they would not have access to video feedback or instructional cues during retention and transfer testing.

After a participant watched the video, they took one practice shot under the instructional guidance of the experimenter and were then shown how the video feedback would be administered. During acquisition, participants completed 25 trials. Each trial began with the experimenter's assistant handing the ball to the participant who was then given a verbal cue to begin the trial. The participant was free to take as much time as needed to prepare the shot. After the trial, the accuracy score was recorded and video feedback was administered as prescribed by the experimental condition. Data were also collected on the frequency of video feedback requests for the SC group and frequency and duration (in seconds) of poster views for both groups. Pilot testing established that a full trial was easily accomplished within 30 s, so the trials during the experiment were spaced at 30 s to equate feedback intervals with post-trial delays on no-feedback trials and to ensure that SC participants did not forego feedback in an effort to shorten their participation. At the conclusion of each trial block, participants were given an extra 30 s break. At the completion of the acquisition phase, participants completed a questionnaire (Appendix B) about their experience receiving the video feedback.

Approximately 24 h following acquisition, participants returned to the facility to complete a 10-trial retention test followed by a 10-trial transfer test. All procedures were similar to acquisition except that no feedback was provided, the instructional cues were not available, and trials were spaced at 15 s. Participants took a normal 30 s break between the end of retention and the beginning of transfer. For retention and transfer tests, shots were taken from the youth and regulation free throw lines, respectively.

Data treatment and analysis

The primary dependent measure was the form score assigned for the first and last trials in each block. Data were also collected for shot accuracy, the number of views of the instructional cues, and the duration of viewing time when participants referred to the cues. For SC participants, frequency of video feedback requests was calculated for each trial block. For the questionnaire, responses to each item were tabulated for the SC and YK groups.

For acquisition, average form scores, accuracy scores, and cue view duration were analyzed using three separate 2 (group) × 5 (block) analysis of variance (ANOVA) with repeated measures on the last factor. The number of instructional cue views by each group during the first and second halves[1] of acquisition were compared in a 2 (group) × 2 (acquisition half) chi-square analysis. Form and accuracy scores on feedback and no-feedback trials were analyzed using two separate 2 (group) × 2 (trial type) ANOVAs with repeated measures on the last factor. For retention and transfer, form and accuracy scores were analyzed in a separate 2 (group) × 2 (block) ANOVAs with repeated measures on the last factor. When appropriate, *F*-ratios involving repeated measures factors were reported with the Greenhouse-Geisser *df* adjustment. Partial eta-squared values (η^2) were reported to indicate effect sizes for significant results. Follow-up testing was conducted using Sidak post hoc procedures. For all analyses, alpha was set as .05.

[1] None of the participants viewed the instructional cue poster on the final trial of acquisition, so this analysis compared Trials 1-12 (first half) to Trials 13-24 (second half).

CHAPTER 4

Results

In this chapter, the results of the present study are discussed. These include the frequency of video feedback requests, form and accuracy scores during acquisition, retention, and transfer (Table 1), frequency and duration of instructional cue viewing, and questionnaire responses. Five hypotheses were forwarded based on the self-control literature. Hypothesis 1 was that the SC group would achieve higher form scores during retention and transfer testing compared to the YK control group. Hypothesis 2 was that the SC group would display a decreasing frequency of feedback requests as the acquisition phase progressed. Hypothesis 3 was that form scores for the SC group would be higher on feedback (*good*) trials than no-feedback (*poor*) trials. Hypothesis 4 was that the SC group would report asking for feedback following *good* trials more frequently than *poor* trials. Hypothesis 5 was that the YK group would report a preference for feedback following *good* trials.

Acquisition

Requests for video feedback. Video feedback request by SC participants decreased across trial blocks. The total frequency was 27% for all acquisition trials. Frequency decreased from Block 1 (33%) to Block 5 (19%).

Form score. Figure 2 shows the mean form scores for the SC and YK groups during acquisition. The SC group displayed higher mean form scores then the YK group throughout acquisition, with the largest difference occurring during Blocks 3 and 5. Analysis of these scores revealed a significant Group × Block interaction, F (4, 104) = 2.93, p = .042, η^2 = .101. Post hoc testing indicated that the SC group scored significantly higher than the YK group on Block 3 (p

= .034) and Block 5 (*p* = .023). Neither the main effect for block, *F* (4, 104) = 2.27, *p* = .091, nor for group, *F* (1, 26) = 3.42, *p* = .076, were significant.

Accuracy. Figure 3 shows the mean accuracy scores for the SC and YK groups during acquisition. Both groups showed improved accuracy scores throughout this phase. This observation was supported by a significant main effect for block, *F* (4, 104) = 2.60, *p* = .040, η^2 = .091. Post hoc testing indicated no reliable differences between individual blocks, but the *p*-values for the comparisons between Block 1 and Blocks 3 and 5 approached the criteria for significance (*p* = .084 and .069, respectively). Neither the main effect for group, *F* (1, 26) = .001, *p* = .976, nor the Group × Block interaction, *F* (4, 104) = .755, *p* = .557, were significant.

Table 1. Overall means (*M*) and standard deviations (*SD*) of form and accuracy scores for both condition during acquisition, retention, and transfer. Higher scores indicate better shooting form and more accurate performance.

		Acquisition					Retention		Transfer	
FB Condition		Block 1	Block 2	Block 3	Block 4	Block 5	Block 1	Block 2	Block 1	Block 2
SC	*M*	2.54	2.76	2.74	2.66	2.91	2.79	2.83	2.80	2.44
	SD	0.75	0.73	0.77	0.79	0.68	0.73	0.54	0.68	0.66
YK	*M*	2.34	2.67	2.94	2.86	2.83	2.70	2.82	2.37	2.44
	SD	0.69	0.56	0.62	0.73	0.66	0.74	0.63	0.86	1.00

SC = Self-Control; YK = Yoked
Note: Neither score has units

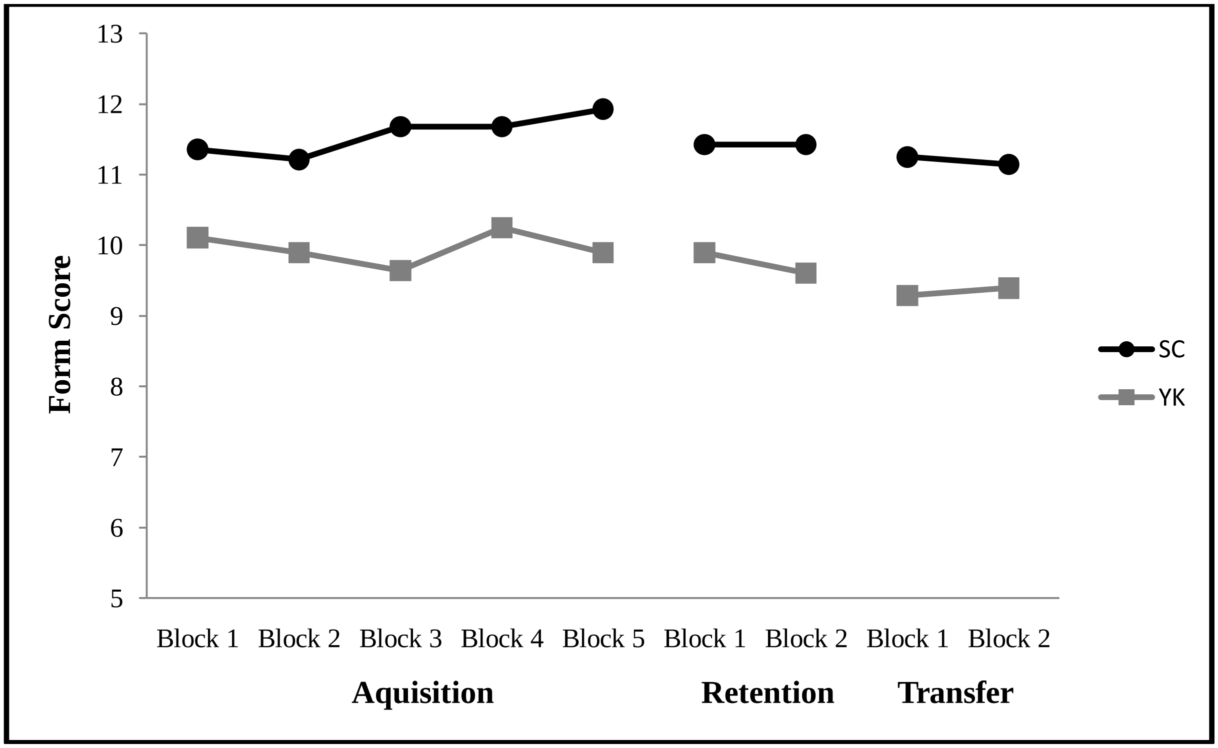

Figure 2. Mean form scores for Self-Control (SC) and Yoked (YK) groups for each trial block during acquisition, retention, and transfer. Higher scores represent better shooting form.

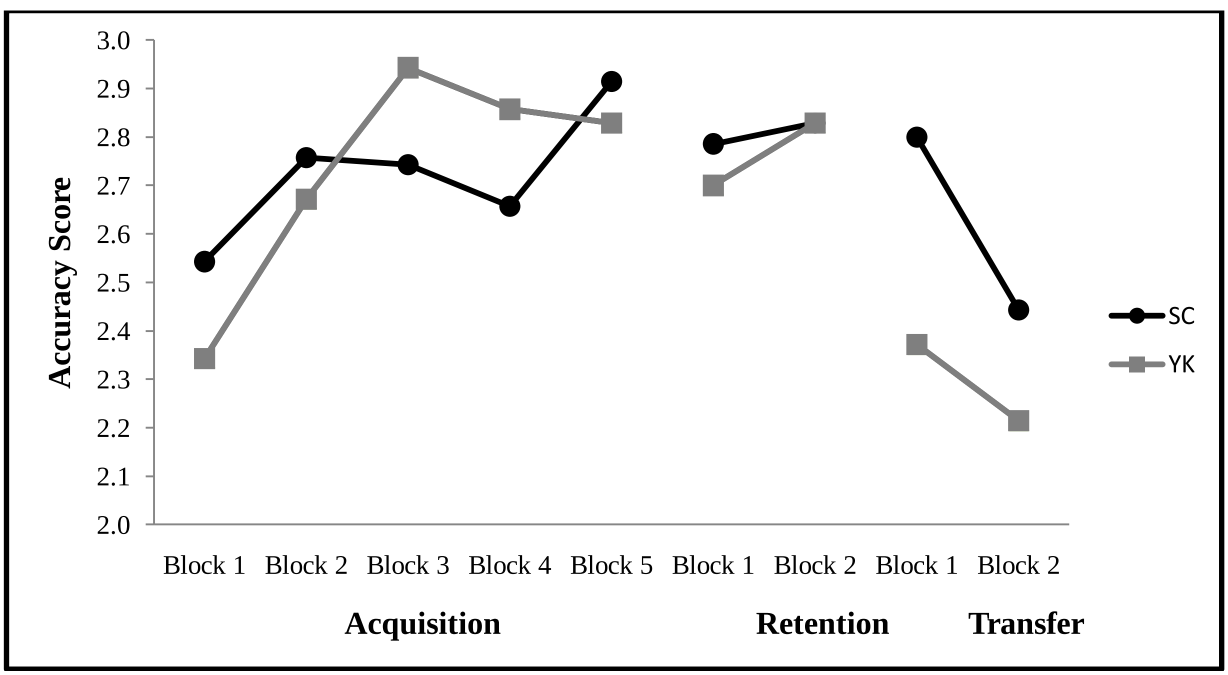

Figure 3. Mean accuracy scores for Self-Control (SC) and Yoked (YK) groups for each trial block during acquisition, retention, and transfer. Higher scores represent more accurate performance.

Instructional cue viewing duration. Figure 4 shows the mean viewing duration for the SC and YK groups during acquisition. The mean amount of time participants viewed the instructional cues during a trial decreased for both groups during acquisition. This observation was supported by a significant main effect for block, F (4, 104) = 3.13, p = .036, η^2 = .108. Post hoc analyses revealed no significant difference from one block to another. Neither the main effect for group, F (1, 26) = 2.18, p = .152, nor the Group × Block interaction, F (4, 104) = .339, p = .776, were significant.

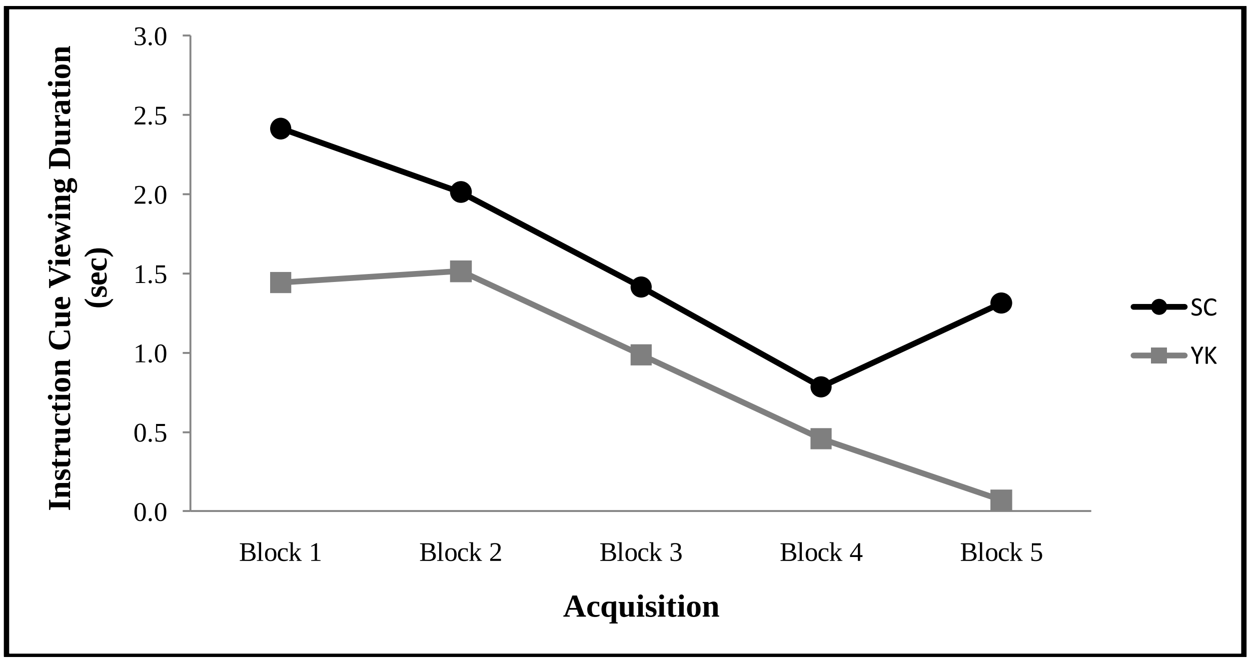

Figure 4. Mean viewing times for Self-Control (SC) and Yoked (YK) groups during each trial block of acquisition. Higher scores represent more time using written cues.

Frequency of instructional cue views. Figure 5 shows the total number of instructional cue views for the SC and YK groups during acquisition. The SC group viewed the cues 34 times during the first half of acquisition and 28 times during the second while the YK group viewed the cues 23 times and 7 times during the first and second halves of acquisition, respectively. The chi-square analysis indicated that the SC group viewed the cues more frequently than expected while the YK group viewed the cues less frequently than expected during both acquisition halves, $\chi^2 = 4.09$, $p = .043$.

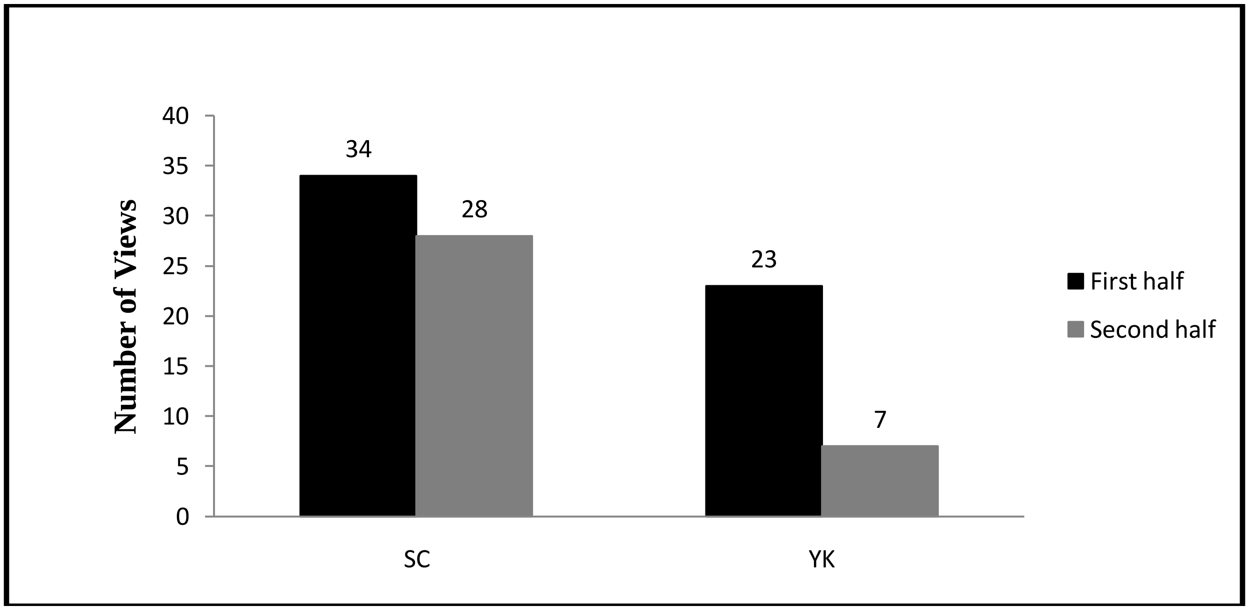

Figure 5. Total number of instructional cue views for Self-Control (SC) and Yoked (YK) groups during acquisition.

Feedback versus no feedback trials. Figure 6 shows mean form scores for feedback trials and no feedback trials for SC and YK groups during acquisition. Form scores on feedback and no feedback trials were very similar for both the SC and YK groups. This observation was supported by the absence of a significant main effect for trial type, F (1, 24) = 1.213, $p = .282$, or Group × Trial Type, F (1, 24) = .258, $p = .616$. The main effect for group, F (1, 24) = 3.31, $p =$ .082, was also not significant.

Figure 7 shows mean accuracy scores for feedback and no feedback trials for SC and YK groups during acquisition. Accuracy scores on feedback and no feedback trials were very similar for both the SC and YK groups. This observation was supported by the absence of a significant main effect for trial type, F (1, 26) = .000, p = .983, or Group × Trial Type, F (1, 26) = 2.69, p = .113. The main effect for group, F (1, 26) = .015, p = .903, was also not significant.

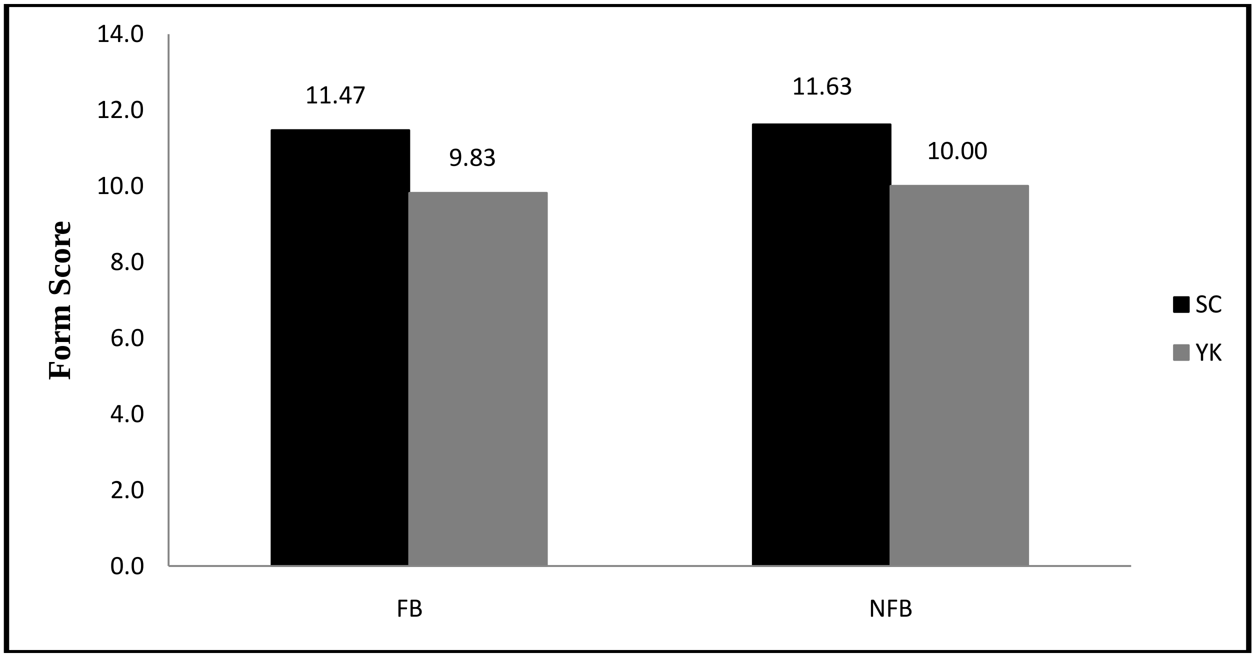

Figure 6. Mean form scores for feedback and no feedback trials for the self-control (SC) and yoke (YK) groups during acquisition.

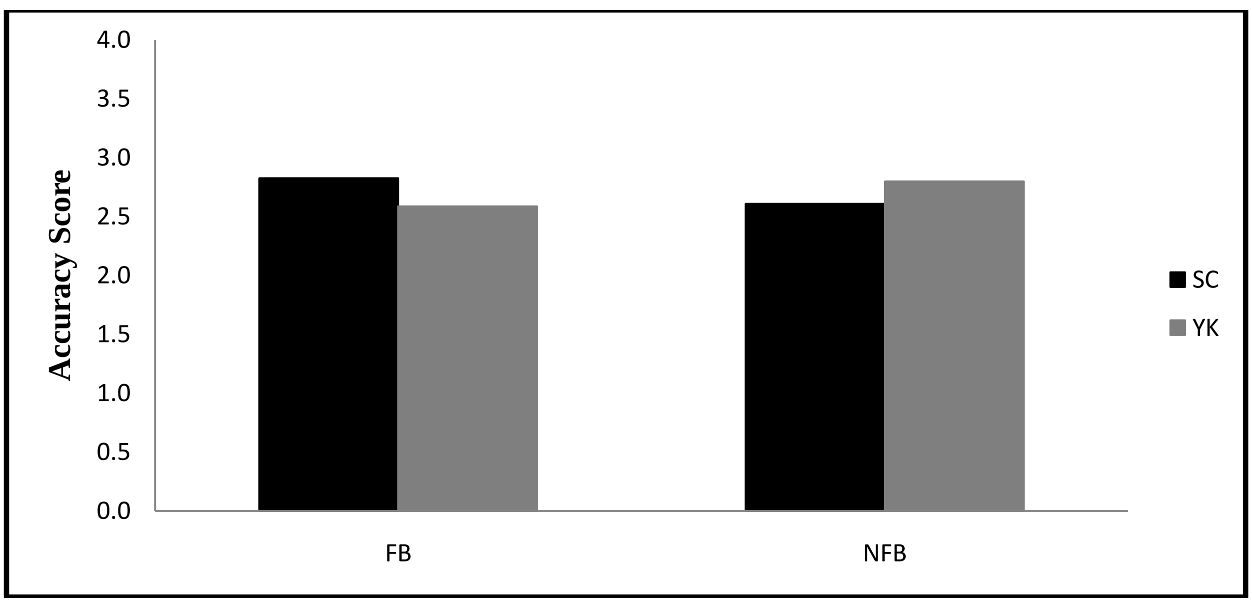

Figure 7. Mean accuracy scores for feedback and no feedback trials for self-control (SC) and yoke (YK) groups during acquisition.

Questionnaire data. The average scores for the Likert-scale items on the post-acquisition questionnaire are reported in Table 2. The SC group indicated that they asked for feedback *occasionally* after both *good* trials (*M* = 2.93; 3 = occasionally) and *poor* trials (*M* = 3.07). The YK group indicated that they received feedback when they needed it *occasionally* (*M* = 3.50). They also indicated that they received feedback *occasionally* after both *good* trials (*M* = 3.21) and *poor* trials (*M* = 3.29). Just under half (*n* = 6) of the YK group indicated a preference for receiving feedback after *good* trials while the others (*n* = 8) indicated a preference for feedback after *poor* trials.

The results from the open-ended questions indicated that several SC participants (*n* = 10) reported *not* asking for video KP for a number of reasons. Some (*n* = 5) chose to *not* receive feedback because their inherent feedback was as expected. That is, they felt their form was close to what was desired. Others (*n* = 4) noted that they already “knew” what they did wrong. One participant did not request feedback due to embarrassment about incorrect form. The results for the question about why they *did* choose feedback after some trials, SC participants indicated that they wanted to confirm their inherent feedback about either correct or incorrect form (*n* = 8) or evaluate their own form (*n* = 5). One participant noted that they had no specific strategy for requesting video KP.

Table 2. Mean scores from questionnaire.

Condition	Question	M	SD
SC	1. Asked for feedback when I thought my form was good	2.93	1.33
	2. Asked for feedback when I thought my form was not good	3.07	0.37
YK	1. I received feedback when I needed it	3.50	1.09
	2. I received feedback after trials when my form was good	3.21	1.12
	3. I received feedback after trials when my form was not good	3.29	1.38

SC = Self-Control; YK = Yoked
Likert scale for all questions: 1-5 (1 = rarely, 3 = occasionally, 5 = frequently)

Retention

Form score. Figure 2 shows the mean form scores for the SC and YK groups during retention. The SC and YK groups performed similarly in terms of form scores. The main effects for group, F (1, 26) = 3.81, p = .062, and for block, F (1, 26) = 2.02, p = .167, were not significant. Neither was the Group × Block interaction, F (1, 26) = 2.02, p = .167.

Accuracy. Figure 3 shows the mean accuracy scores for the SC and YK groups during retention. The SC and YK groups performed similarly in terms of accuracy scores. The main effects for group, F (1, 26) = .057, p = .812, and for block, F (1, 26) = .235, p = .632, were not significant. Neither was the Group × Block interaction, F (1, 26) = .059, p = .81.

Transfer

Form score. Figure 2 shows the mean form scores for the SC and YK groups during transfer. The SC group produced higher form scores than the YK group. This observation was supported by a significant main effect for group, F (1, 26) = 4.67, p = .04, η^2 = .153. Neither the main effect for block, F (1, 26) = 0.00, p = 1.00, nor the Group × Block interaction, F (1, 26) = .436, p = .515, were significant.

Accuracy score. Figure 3 shows the mean accuracy scores for the SC and YK groups during transfer. The SC and YK groups performed similarly in terms of accuracy score during transfer. The main effects for block, F (1, 26) = 2.59, p = .12, and group, F (1, 26) = 1.57, p = .221, were not significant. Neither was the Group × Block interaction, F (1, 26) = .392, p = .537.

CHAPTER 5

Discussion

The purpose of the present study was to examine the effects of self-controlled video KP on the learning basketball set-shot technique by novices. Five hypotheses were forwarded based on the self-control literature. Hypothesis 1 was that the SC group would achieve higher form scores during retention and transfer testing compared to the YK group. Hypothesis 2 was that the SC group would display a decreasing frequency of feedback requests as the acquisition phase progressed. Hypothesis 3 was that form scores for the SC group would be higher on feedback (i.e., *good*) trials than no-feedback (i.e., *poor*) trials. Hypothesis 4 was that the SC group would report asking for feedback following *good* trials more frequently than *poor* trials. Hypothesis 5 was that the YK group would report a preference for feedback following *good* trials.

The most important contribution of the present study was the demonstration that self-control of video KP facilitated learning of set-shot technique as evidenced by form scores during transfer. Janelle, Barba, Frehlich, Tennant, & Cauraugh (1997), previously demonstrated that self-controlled video KP in conjunction with verbal KP from an experienced instructor facilitated learning for an overhand throw. Although the inclusion of verbal KP followed Rothstein and Arnold's (1976) suggestion to use verbal cues to enhance the effectiveness of video feedback, it also introduced a confound that prevented a clear demonstration that self-control manipulations might extend to the use of video KP, per se. The results of the current study supported the first hypothesis that predicted a learning benefit in form scores for the SC group compared to the YK group. The benefits of self-control were also evident during Blocks 3 and 5 of acquisition, but the absence of a group difference during Block 1 indicated that they were not likely due to initial differences.

The results regarding feedback request frequencies were consistent with previous research (e.g., Chiviacowsky & Wulf, 2002; Janelle et al., 1997). The decreasing frequency of requests by the SC group from 33% during Block 1 to 19% during Block 5 supported the second hypothesis that predicted such decreasing requests. Other findings were not consistent with results reported by previous studies. For example, no differences in form or accuracy scores were observed between feedback and no-feedback trials. Chiviacowsky and Wulf (2002) reported that SC participants requested feedback after so-called *good* trials more frequently than after *poor* trials. The accuracy of these perceptions was confirmed by the finding that feedback trials were more accurate than no-feedback trials. In two follow-up studies, Chiviacowsky and Wulf (2005, 2007) demonstrated that learning in a self-controlled feedback protocol was superior when the decision to request feedback followed rather than preceded a trial and that feedback for the most accurate trials in a block facilitated learning more than feedback for the least accurate. Taken together, the three Chiviacowsky and Wulf studies argued that feedback after *good* trials facilitates learning more than after *poor* trials and that the benefit of self-controlled feedback is tied to both an evaluation of performance and a decision to seek feedback when that performance is determined to be *good*. The third hypothesis of the current study (i.e., that form scores would be higher on feedback trials compared to no-feedback trials) was based on this reasoning, but the results did not provide evidence to support it. Consequently, the current study calls into question the necessity of requesting feedback after *good* trials as a direct mechanism for self-control benefits.

The questionnaire also revealed findings that were inconsistent with earlier research. SC participants reported that they requested feedback occasionally after both *good* and *poor* trials whereas Chiviacowsky and Wulf (2002) reported that 67% of participants indicated requesting feedback mostly after *good* trials (none indicated doing so after *poor* trials). This discrepancy was possibly due to different questionnaire formats. The Chiviacowsky and Wulf (2002) questionnaire item asking about when feedback was requested included five categorically distinct response options (e.g., “mostly” after *good* trials or “mostly” after *poor* trials). The questionnaire in the current study changed the response options to a Likert scale so that participants could indicate the frequency with which they requested feedback after both *good* and *poor* trials (with responses ranging from “rarely” to “frequently”). Thus, the reported frequencies for each trial type were free to overlap, which allowed for the possibility that feedback might be requested for different reasons on different trials. Indeed, the current results indicated that SC participants requested feedback after both *good* and *poor* trials only *occasionally* (which represented the middle value on the scale), contrary to the fourth hypothesis that predicted a greater frequency for *good* trials. Interestingly, the YK participants indicated a similar pattern in their perceptions of receiving feedback *occasionally* after both *good* and *poor* trials. Thus, the current results produced no evidence that perceptions about the quality of a trial were systematically linked to whether or not feedback was requested or received. The questionnaire also produced no evidence to support the fifth hypothesis, that YK participants would indicate a *preference* for feedback following *good* trials. Approximately half the YK participants reported that they would have liked to receive feedback after *good* trials while the other half indicated a preference for feedback after *poor* trials. Taken together, the results of the quantitative portion of the questionnaire suggested that participants might not have a clear preference for receiving feedback after *good* trials as suggested by Chiviacowsky and Wulf (2002). Another possibility is that the participants were unable to tell the difference between *good* and *poor* trials, an interpretation that appears to be supported by the finding that both form and accuracy scores did not differ for the feedback and no-feedback trials.

The absence of a preference for receiving feedback after *good* trials might have been due to the type of feedback used in the current study. As Rothstein and Arnold (1976) pointed out, video feedback can convey large amounts of information, which could presumably deal with a wide range of form characteristics reflecting various degrees of quality. For example, a participant might have elected to view video KP because of an issue related to her follow-through, which in one case might have been executed well at the end of an otherwise *poor* trial and in another case executed poorly at the end of an otherwise *good* trial. This possibility introduces a bit of a conundrum for understanding exactly how learners might use complex feedback information such as that presented in video KP. The open-ended responses from the questionnaire indicated that participants asked for feedback to either confirm their intrinsic feedback or evaluate their form. Both of these reasons could be consistent with traditional views of augmented feedback as providing corrective information used to guide future performance (e.g., Salmoni, Schmidt, & Walter, 1984) or with Chiviacowsky and Wulf's (2002) contention that learners use feedback to confirm successful outcomes. Moreover, the primary reason for *not* requesting feedback—that inherent feedback was as expected—could also fit either perspective. Indeed, some participants indicated that they did not request feedback because they "knew" their form was "correct" while others didn't do so because they "knew" their form was "incorrect". One participant also indicated that she declined to request video VP out of embarrassment, which indicates that other factors (e.g., expectations with respect to social norms) unrelated to the self-control manipulation or feedback manipulations in general might have influenced some participants' feedback decisions. Overall, the results of the questionnaire in combination with the lack of differences between feedback and no-feedback trials indicated that the use of feedback in at least some self-control settings is more complex than has been previously described.

Another finding that warrants discussion was the participants' use of the written instructional cues provided during acquisition. Janelle and colleagues (1995, 1997) suggested that the benefits of self-controlled feedback might be due to deeper information processing related to the task. Such deeper engagement in the learning process might be manifested in the number of resources that a participant uses during practice. That is, it would be expected that a more engaged learner would use more sources of information to facilitate the learning process. The finding that the SC group viewed the instructional cues more frequently than expected was consistent with this perspective and provides a plausible explanation for the superior form they ultimately demonstrated during transfer. Although the additional viewing was not associated with increased accuracy it seems reasonable to expect that success in one aspect of a task (shooting form) might enhance a learner's motivation to continue practicing until benefits in shooting accuracy would eventually become observable.

Taken together, the results of the present study extend the possible benefits of self-controlled feedback during skill acquisition to the use of video KP by demonstrating superior movement form for SC participants during transfer trials. However, they also suggest possible shortcomings in current explanations regarding *how* learners use feedback in self-control protocols. Although it appeared that participants' reasons for requesting feedback are tied to some form of subjective evaluation of performance, as suggested by Chiviacowsky and Wulf (2002), the present results suggested that such evaluation might not always be consistent with other measures of performance. There was no evidence to suggest that participants could distinguish between *good* and *poor* trials or that they used feedback as a way to confirm a successful (with respect to either form or accuracy) performance. When learning a complex task such as the basketball set-shot, it appears likely that learners might seek video feedback information for a variety of reasons related to their performance (e.g., confirmation or error correction). Chiviacowsky and Wulf (2002) argued that confirmation of success indicated the potential importance of the motivational function of augmented feedback. However, the present findings suggest that the role(s) that augmented feedback and learners' opportunity to control its presentation plays in learning might vary according to type of tasks being learned and feedback being presented. Thus, it appears that more research is needed to better understand how feedback operates within self-control protocols.

Summary of procedures

Upon arrival to the facility, participants informed about the parameters of the study and asked to sign an informed consent form (Appendix A). Participants were assigned an ID number and selected a pseudonym. They then were told that their goal was to improve their basketball set-shot form with the aid of video KP. SC participants were told that they would have control over the amount of feedback they received, and YK participants were told that they would receive feedback according to a pre-determined schedule. All participants watched an instructional video on proper shooting form that included a demonstration and seven instructional cues. Video feedback and the instructional cues (written on a poster board) were available only during acquisition.

All participants performed one trial after which they received video KP to acclimate them to the procedures of the study. Acquisition consisted of 25 trials (5 blocks of 5 trials) requiring the performance of the set-shot from a 12 foot (3.66 m) youth free throw line. All shots were made using an NCAA regulation goal and woman's basketball. The intertrial interval was 30 s and the break between blocks was one minute. Participants were scored on both shooting form and shot accuracy. For form scores, videotape of the first and last trials of each block was rated by an expert with respect to the presence of the seven shot features included in the instructional cues. Following acquisition, participants completed a questionnaire and then returned the next day to complete a 10-trial retention test (2 blocks of 5 trials). Following retention, participants completed a 10-trial transfer test in which they shot from a 15 ft (4.57 m) regulation free throw line.

Summary of findings

The experiment revealed significant results for shooting form score, shot accuracy, instructional cue viewing frequency. In addition, several non-significant findings related to questionnaire responses revealed inconsistencies with previous research.

Acquisition

Form. Form scores revealed a significant Group × Block interaction, F (4, 104) = 2.93, p = .042, η^2 = .101. Post hoc testing indicated that the SC group scored significantly higher than the YK group on Block 3 (p = .034) and Block 5 (p = .023).

Accuracy. Accuracy scores revealed a significant main effect for block, F (4, 104) = 2.60, p = .040, η^2 = .091. Post hoc testing indicated no reliable differences between individual blocks, but the p-values for the comparisons between Block 1 and Blocks 3 and 5 approached the criteria for significance (p = .084 and .069, respectively).

Instructional cue viewing duration. The mean amount of time participants viewed the instructional cues during a trial decreased for both groups during acquisition. This observation was supported by a significant main effect for block, F (4, 104) = 3.13, p = .036, η^2 = .108.

Frequency of instructional cue viewing. A chi-square analysis indicated that the SC group viewed the cues more frequently than expected while the YK group viewed the cues less frequently than expected, $\chi^2 = 4.09$, $p = .043$.

Feedback vs. no feedback trials. No differences were detected in form scores or shot accuracy between feedback and no feedback trials.

Questionnaire data. The SC group indicated that they asked for feedback *occasionally* after both *good* trials ($M = 2.93$; 3 = occasionally) and *poor* trials ($M = 3.07$). The YK group indicated that they received feedback when they needed it *occasionally* ($M = 3.50$). They also indicated that they received feedback *occasionally* after both *good* trials ($M = 3.21$) and *poor* trials ($M = 3.29$). Just under half ($n = 6$) of the YK group indicated a preference for receiving feedback after *good* trials while the others ($n = 8$) indicated a preference for feedback after *poor* trials.

Retention

There were no significant results for form scores and shot accuracy during retention.

Transfer

The SC group produced significantly higher form scores than the YK group. This observation was supported by a significant main effect for group, $F(1, 26) = 4.67$, $p = .04$, $\eta^2 = .153$. There were no significant results for shot accuracy during transfer.

Conclusions

The findings of the present study suggest the following conclusions:

1. Self-control of video KP facilitated learning of the basketball set shot as evidenced by superior form scores for the SC group compared to the YK group during transfer.

2. The provision of self-control might have fostered deeper engagement during the learning process (Janelle et al., 1995, 1997) as evidenced by the greater frequency of instructional cue viewing by the SC group compared to the YK group during acquisition.
3. The benefits of self-controlled video KP were not dependent upon requesting feedback following *good* trials more so than *poor* trials. Reasons for requesting feedback appear to be more complex than explanations relying on a categorical difference between needing information to correct errors versus confirming success.

Limitations

1. The presentation of video KP was only provided at regular playback speed. It might been helpful to provide video KP either at half speed or in a frame-by-frame fashion to allow more opportunity to focus on selected aspects of the movement
2. The number of shots participants attempted during acquisition was limited to 25, which might not have been sufficient for acquiring a complex, multiple degree-of-freedom movement.
3. The use of only one expert rater prevented calculations of inter-rater reliability of form scores.

Recommendations

The following recommendations for future research are suggested by the present findings:

1. The inclusion of a more detailed post-acquisition interview to more fully evaluate the reasons for trial-by-trial decisions about feedback requests.

2. An examination of a wider variety of tasks and feedback modalities to better understand how feedback supports learning in self-control protocols.
3. A greater number of acquisition trials over possibly more than one day for examining the effect of self-controlled feedback on the learning of complex, multiple degree-of-freedom tasks.
4. An examination of self-control video KP presented at half speed or frame by frame.

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APPENDICIES

Appendix A

INFORMED CONSENT STATEMENT

INTRODUCTION

You are invited to participate in a research study to examine the effects of self-controlled video feedback on the basketball free throw.

INFORMATION ABOUT PARTICIPANTS' INVOLVEMENT IN THE STUDY

Should you decide to participate in this study, you will participate at a time of your choosing. During the experiment you will, be taught how to shoot a basketball, watch a video of an expert shooting a basketball free throw properly, and will be shooting a basketball free throw and attempting to improve your shooting form by watching video of yourself shooting. The study should last approximately 30 minutes. Your performance will be video recorded and then rated for further analysis.

RISKS

The risks of participation are minimal. You will be asked to select a pseudonym - a fake name -, which will be substituted for your real name whenever the video is analyzed at a further date. This is done to help preserve the confidentiality of your identity. Further, in an effort to preserve your confidentiality your video will only be shared with raters of the study. All those people will sign a pledge of confidentiality statement to further protect your identity.

BENEFITS

The current study will enhance the general body of knowledge in both the self-controlled literature and the video feedback literature. If positive results are found, we will better understand that observational learning transfers to the viewing of oneself and can be sufficient information to teach complex movements.

CONFIDENTIALITY

All video recordings will be stored in a secure location and will be made available only to persons conducting the study unless you specifically give permission in writing for me to do otherwise. Once your data is scored, the recording will be erased. Upon completion of the study, all information that matches you with your video will be destroyed.

CONTACT INFORMATION

If you have questions at any time about the study or the procedures, (or you experience adverse effects as a result of participating in this study,) you may contact Christopher Aiken at (702) 521-3775. If you have questions about your rights as a research participant, you may contact the Office of Research Compliance Officer at (865) 974-3466.

STATEMENT OF CONSENT

I understand that my participation in this study is voluntary. I have read the above information and have had all my questions answered to my satisfaction. If I decide to participate, I am aware that I may withdraw from the study at any time without penalty. If I withdraw from the study before data collection is completed my data will be returned or destroyed. I agree to participate in this study and understand that I will be given a copy of this consent form.

Participant's signature ______________________________ Date ___________

Investigator's signature _____________________________ Date ___________

Appendix B

Self-Control Condition

1. I asked for feedback after trials when I thought my form was good

1	2	3	4	5
Rarely		Occasionally		Frequently

2. I asked for feedback after trials when I thought my form was **not** good

1	2	3	4	5
Rarely		Occasionally		Frequently

3. Think about the trials when you chose **not** to receive feedback. Did you have a specific reason for deciding **not** to ask for feedback? If so, please explain.

____

____

4. Think about trials when you chose to receive feedback. Did you have a specific reason for deciding to ask for feedback? If so, please explain.

____

____

5. How did you decide to use the feedback that was available to you?

____

____

Yoked Condition

1. I received feedback when I needed it

1	2	3	4	5
Rarely		Occasionally		Frequently

2. I received feedback after trials when my form was good

1	2	3	4	5
Rarely		Occasionally		Frequently

3. I received feedback after trials when my form was **not** good

1	2	3	4	5
Rarely		Occasionally		Frequently

4. If I had been allowed to control when I received feedback, I would have preferred to receive it (chose one):

- □ When I thought my form was good
- □ When I thought my form was **not** good

*Adapted from Chiviacowsky and Wulf, 2002

Appendix C

Expert Basketball Shooting Form Rater Pledge of Confidentiality

As an expert rater on the basketball free throw, I understand that I will be viewing confidential videos of the study "The Effects of Self-Control Video Feedback on the Basketball Set Shot." The information in these videos has been revealed by the researcher who participated in this research study on good faith that their interviews would remain strictly confidential. I understand that I have a responsibility to honor this confidentiality agreement. I hereby agree not to share any information in these transcriptions with anyone except the investigator Christopher Aiken or the faculty advisor. Any violation of this agreement would constitute a serious breach of ethical standards and I pledge not to do so.

Expert Rater Signature: ________________________________ Date:

VITA

Christopher Adam Aiken was born in Henderson, NV on August 12, 1982. He was raised in Henderson attending public schools through High School, where he graduated from Basic High School in the spring of 2000. After High School, he served a mission for the Church of Jesus Christ of Latter-day Saints in Sao Paulo, Brazil from November 2001 to November 2003. He then pursued his education in Psychology from the University of Nevada, Las Vegas (UNLV) and graduated in 2007 with a B.A. Christopher completed his master's degree in kinesiology from the University of Tennessee, Knoxville in 2011 and was admitted to the PhD program in Kinesiology at Louisiana State University.