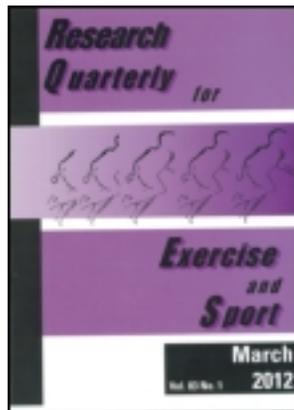


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### Self-Controlled Observational Practice Enhances Learning

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# Self-Controlled Observational Practice Enhances Learning

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*Key words:* basketball, modeling, self-control, video

Learning through observation, or modeling, is a commonly used technique in teaching motor skills. It has also intrigued researchers interested in understanding the principles underlying the phenomenon of observational learning and has resulted in many studies examining the effectiveness of this practice method (for a review, see McCullagh & Weiss, 2001). In general, although observational practice is not as effective as physical practice, it is a viable training method (e.g., Landers & Landers, 1973; Martens, Burwitz, & Zuckerman, 1976; Sidaway & Hand, 1993). This seems to be the case particularly for relatively complex motor skills (Wulf & Shea, 2002). Wulf and Shea argued that there might be fundamentally more to “see” and, therefore, more to be extracted as the result of observing relatively complex tasks compared to simple tasks. Furthermore, observational practice enables the observer to engage in processing that would perhaps not be possible early in practicing a complex skill, when most of the performer’s cognitive resources are required to perform the new task (e.g., Shea, Wright, Wulf, & Whitacre, 2000). That is, the observer may be able to extract information concerning appropriate coordination patterns, subtle task requirements, and/or evaluate effective or ineffective strategies that would be difficult, if not impossible, to do while attempting the new task. Because of the unique

contributions of observational and physical practice, alternations of observational and physical practice have been particularly beneficial and more effective than either observational or physical practice alone (e.g., Shea et al., 2000; Shea, Wulf, & Whitacre, 1999).

A recent study examined whether giving the learner control over the model presentation schedule could enhance learning, if observational and physical practice are combined (Wrisberg & Pein, 2002). In fact, several studies demonstrated that self-controlled practice can benefit the effectiveness of motor skill learning. For example, giving learners the opportunity to self-select their feedback schedule has been found to be more effective for learning than a prescribed feedback schedule (yoked condition; Chiviawowsky & Wulf, 2002; Janelle, Barba, Frehlich, Tennant, & Cauraugh, 1997; Janelle, Kim, & Singer, 1995). Furthermore, the self-controlled use of physical assistance devices (ski poles on a ski simulator) led to the development of a more effective and efficient movement pattern than practice without self-control (Wulf, Clauss, Shea & Whitacre, 2001; Wulf & Toole, 1999). Wrisberg and Pein (2002) examined the effectiveness of a self-controlled observational practice condition by comparing it to a condition in which the model was shown before each trial (100%), and a group that never saw the model (control). The task was a badminton long serve, and an expert model was presented as a video. In a retention test, the self-control and the 100% groups had similar movement form scores, and both were more effective than the control group. This was seen as preliminary support for the effectiveness of giving learners the opportunity to decide when they wanted to view a model. However, the authors also acknowledged the confound of self-control and the frequency of the model presentations in their study. The self-control group viewed the model on 9.8% of the practice trials, as compared to

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100% and 0% of the trials. Thus, because a yoked control group was lacking, it cannot be determined from these results whether the learning advantages of the self-control condition were due to the fact participants could self-select the model frequency (and schedule) or the reduced modeling frequency.

Therefore, the present study compared the effectiveness of a self-control modeling condition with that of a yoked condition. As each participant in the self-control group was yoked to a partner in the yoked control condition, the frequency and scheduling of the model presentations were, on average, identical for both groups. The only difference between the groups was that self-control participants had control over the model presentations, whereas yoked participants did not. If the previously found benefits of self-control generalized to observational learning, this could have important implications for practical settings. For example, the effectiveness and efficiency of training could be enhanced, if the learner had control over the model presentations, as compared to prescribed observational practice regimens.

Participants without prior experience with the basketball jump shot practiced this skill under self-controlled or yoked observational practice conditions. A video of a skilled model could either be requested (self-control) or was provided at the appropriate times (yoked) during the practice phase. To assess the learning effects of these conditions, participants performed a retention test 1 week later during which no model presentation was provided. As presentations of a skilled model were expected to affect mainly movement form (or quality; e.g., McCullagh & Meyer, 1997; Weeks & Anderson, 2000), expert ratings were used to assess movement form. We also measured the accuracy of the throws, as one might expect to see a greater shooting accuracy as a function of improved movement form. Thus, if the learning advantages of self-controlled practice generalize to observational practice, allowing learners to decide when they want to view a model presentation should result in enhanced retention performance, with regard to movement form and, perhaps, movement accuracy, compared to that of yoked learners.

## Method

### Participants

Twenty-six high school and university students (16 men, 10 women) participated in this experiment. The study was conducted in Germany, where basketball is far less popular than it is, for example, in the United States. Thus, it was assumed that participants were relatively unfamiliar with the task (basketball jump shot). All gave their informed consent prior to participating in the

study. All were right-handed and were naive as to the purpose of the experiment.

### Apparatus and Task

The experiment was conducted on a regular indoor basketball court. The participants' task was to perform jump shots from the free-throw line (4.60 m from the basket). The basket had the standard height (3.05 m) and served as the target. Five basketballs were available for participants to use. All shots were videotaped for later analysis. The video camera was positioned at a height of approximately 1.5 m, a distance of about 5 m, and an angle of about 60° to the front and right of the performer. The video model of an expert basketball player was custom made. It was 25 s in duration and consisted of a sequence of 5 clips showing the model performing a jump shot from different angles and perspectives. This allowed the learner to observe different aspects of the technique in more detail.

### Procedure

Participants were randomly assigned to the self-control and yoked groups, with the restriction that each self-control participant was paired with a yoked participant of the same sex. All participants were informed that they would (a) have to practice the basketball jump shot, (b) have 25 practice trials, and (c) be retested 1 week later. They were instructed to perform the throws from the free-throw line, with the goal being to hit the basket. The instructions also emphasized the importance of the quality of the movement. Participants were able to see a video model and asked to try to imitate the movements of the model as closely as possible. Their shots were videotaped for later analysis, and their movement form was assessed in addition to the accuracy of the shots. Participants were then shown the video model once.

The subsequent instructions differed for participants in the self-control and yoked conditions. Self-control participants were told they were free to watch the video at any time as often as they wanted during the practice phase and could use it as a general reminder or to observe more specific details of the technique. Yoked participants were informed that the video model would be shown again from time to time during the practice phase, as a general reminder or to enable them to observe more specific details of the technique. Participants were tested individually. Two experimenters recorded the accuracy score of each shot and the time (trial number) of the model presentations. One week later, all participants performed a retention test consisting of 10 trials. No video model was available during retention, but participants were again reminded to pay particular attention to the movement quality in addition to throwing accuracy.

## Data Analysis

Movement quality was assessed based on the following criteria (e.g., Hagedorn, Niedlich, & Schmidt, 1996; Knoller & Riedelsheimer, 1995): (a) stable throwing position as a result of vertical jump; (b) rapid lift of the ball to at least forehead height, simultaneous with jumping motion; (c) elbow under the ball, pointing to the basket, angle between upper arm and upper body greater than 90°; (d) delayed throwing motion, ball released shortly before or at the highest point; (e) hand of the throwing arm under the ball, wrist flexed during the throwing motion; the other hand supports the ball from the side; and (f) arm extended during the follow through. Two raters, who were blind to the practice condition, first assessed the quality of the serves independently and awarded a score. If there was a discrepancy between the two ratings, the raters discussed the trial until they agreed on a score. The scores ranged between 0 and 12, with the highest indicating perfect performance. For each of the six criteria, participants received either a score of 2 (clearly recognizable), 1 (vaguely recognizable), or 0 (not recognizable).

Movement accuracy was measured as follows: balls going through the basket received 5 points; balls that touched the ring received 3 points; balls that touched both the board and the ring received 2 points; and balls that touched only the board got 1 point. If the ball touched neither the basket nor the board, 0 points were recorded.

The form and accuracy scores were analyzed in 2 (group) x 5 (blocks of five trials) analyses of covariance (ANCOVA), with performance on the first practice trial as a covariate (to account for initial group differences) and with repeated measures on blocks. For retention, the form and accuracy scores were analyzed in 2 (groups) x 2 (blocks of five trials) ANCOVAs.

## Results

### Practice

On average, self-control participants requested a presentation of the model 1.5 times (with a range from 1 to 3). They requested more demonstrations relatively early in practice. Specifically, participants viewed most of the presentations (eight) within the first block of five trials. They requested three presentations in Block 2, four in Block 3, two in Block 4, and one in Block 5.

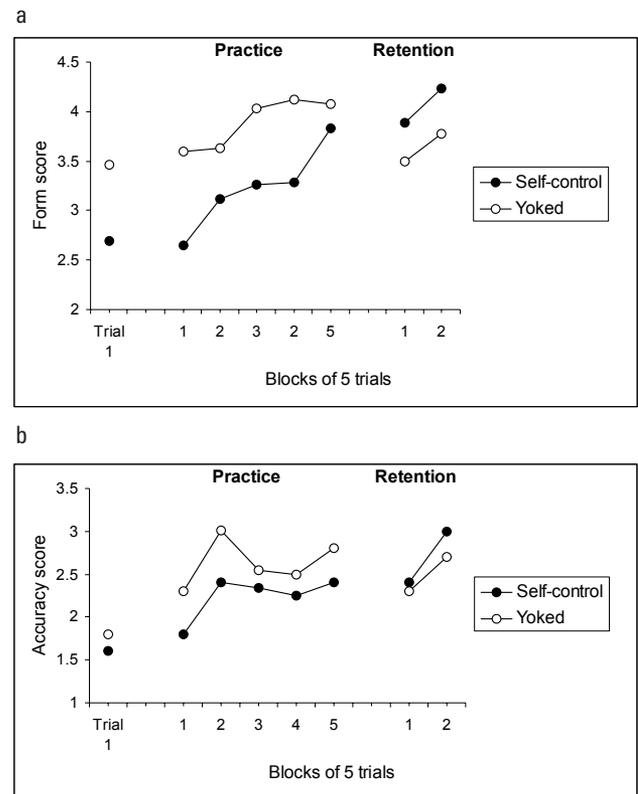
*Form.* Both group showed an increase in form scores across practice (see Figure 1a, left). The yoked group had a somewhat higher skill level than the self-control group at the beginning of practice, including the first trial. However, self-control participants tended to demonstrate a greater improvement in movement form rela-

tive to yoked participants. The main effect of block,  $F(4, 92) = 3.29, p < .05$ , was significant. The main effect of group,  $F(1, 23) < 1$ , and the interaction of group and block,  $F(2, 92) < 1$ , were not significant.

*Accuracy.* The yoked group appeared to be slightly more effective in shooting accuracy than their self-control counterparts (see Figure 1b, left). However, both groups showed an increase in accuracy scores across practice. The main effect of block was significant,  $F(4, 92) = 5.27, p = .001$ , while the main effect of group,  $F(1, 23) = 2.89, p > .05$ , and the Group x Block interaction,  $F(4, 92) < 1$ , were not significant.

### Retention

*Form.* At the beginning of the retention test, the form scores of the self-control group were similar to those at the end of practice, and they continued to improve across retention (see Figure 1a, right). In contrast, the yoked group demonstrated a drop in performance from the end of practice to the beginning of retention, although yoked participants also increased their form scores across blocks. Overall, the self-control group had higher form scores than the yoked group throughout retention. The main effect of group,  $F(1, 23) = 5.16, p < .05$ , and the main effect of



**Figure 1.** Movement form scores (a) and movement accuracy scores (b) of self-control and yoked group during practice and retention.

block,  $F(1, 23) = 6.42$ ,  $p < .05$ , were significant. There was no interaction of group and block,  $F(1, 23) < 1$ .

*Accuracy.* Similar to form scores, the self-control group continued to increase their accuracy scores from the level they had reached at the end of practice, whereas the yoked group showed a performance decrement from the last practice block to the beginning of retention (see Figure 1b, right). Both groups tended to improve their throwing accuracy across retention, but the main effects of block,  $F(1, 23) = 1.51$ ,  $p > .05$ , was not significant. Also, the main effect of group,  $F(1, 23) < 1$ , and the Group x Block interaction,  $F(1, 23) < 1$ , were not significant.

## Discussion

In general, participants' form and accuracy scores were relatively low. Presumably, this was due to their relative lack of experience with basketball, in general, and jump shots, in particular. Nevertheless, the results of the present experiment demonstrate that giving learners the opportunity to decide when and how often they saw the model can be effective. Although the self-control group started out at a lower performance level (presumably due to initial group differences in skill level), the early performance differences became smaller with practice. Importantly, after the 7-day retention interval, the self-control group clearly outperformed the yoked group. Moreover, in contrast to yoked learners, self-control participants did not show any performance decrements across the retention interval. (A repeated measures analysis of variance, including the last practice block and the first retention block, revealed a marginally significant interaction of group and block,  $F(1, 24) = 4.05$ ,  $p = .055$ .) This result is reminiscent of the findings of Wulf and Toole (1999; see also Janelle et al., 1995). They found no retention loss for a group with self-control of physical assistance devices but a considerable retention loss for a yoked control group. In other studies, performance decrements were smaller for self-control than yoked learners (e.g., Chiviacowsky & Wulf, 2002; Janelle et al., 1997). This suggests that self-controlled practice results in different—and more effective—information-processing activities than those in which learners without self-control engage (these are discussed below).

In contrast to movement form, the self-control and yoked groups did not differ in movement accuracy during practice or retention. However, the trends were similar to those seen for movement form, with the yoked group showing a retention loss that was not present for the self-control group and self-control participants outperforming yoked performers in retention. The lack of statistical difference between the two conditions is not too surprising, given that the demonstration of an

expert model would be expected to affect movement form, and this finding is consistent with other studies (McCullagh & Meyer, 1997; Weeks & Anderson, 2000; Wrisberg & Pein, 2002).

Self-control participants in the present study requested a model demonstration, on average, on 1.5 trials or 5.8% of the practice trials. In the Wrisberg and Pein (2002) study, this frequency was 9.8%. While these frequencies appear to be rather low, the fact that group differences emerged underlines the potency of self-control for learning. From the present results, it cannot be determined whether the self-control condition was *optimal* for learning, as conditions with different model-presentation frequencies (e.g., 100%) were not included. However, in the Wrisberg and Pein (2002) study, the presentation frequency was only slightly higher (9.8%) than in the present study, and it led to the same retention performance as model presentations on 100% of the practice trials. Although comparisons with other frequencies (e.g., 0% or 100%) are lacking and would be desirable in future studies, these results suggest that relatively few model presentations might be sufficient—provided learners have control over the model presentations.

Overall, the present results add to the increasing evidence for the learning advantages of self-controlled motor learning (e.g., Chiviacowsky & Wulf, 2002; Janelle et al., 1995, 1997; Wulf et al., 2001; Wulf & Toole, 1999). Our findings demonstrate that the benefits of self-control generalize to observational learning. The challenge for future research is to develop and examine possible explanations for the advantages of self-control in general, and specifically with regard to observational learning. Although self-controlled practice might have beneficial influences on learning—for example, through increased motivation and a more active involvement in the learning process (e.g., Bandura, 1993; Boekaerts, 1996; Ferrari, 1996; McCombs, 1989), or the consistency of the practice schedule with the learner's needs (Chiviacowsky & Wulf, 2002)—there might be additional benefits more specific to the factor being controlled. For observational learning, this might refer to the amount or type of information learners extract from the model presentation (e.g., Scully & Newell, 1985; Shea et al., 2000). That is, performers might extract more, or more relevant, information from the model when they can request a presentation, as opposed to a situation in which the presentation schedule is determined for them. For example, self-control learners might pay particular attention to aspects of the movement pattern they are uncertain about—either to confirm their movements are correct or identify errors. In contrast, yoked participants might be less inclined to engage in such information-processing activities due to the unpredictability of the model presentations. The use of questionnaires in future studies might shed light on the viability of this hypothesis. Investigations into various possible functions of

self-control should eventually lead to a better understanding of this important variable for motor learning.

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