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VIDEO MODELING BY EXPERTS WITH VIDEO FEEDBACK TO ENHANCE GYMNASTICS SKILLS

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The effects of combining video modeling by experts with video feedback were analyzed with 4 female competitive gymnasts (7 to 10 years old) in a multiple baseline design across behaviors. During the intervention, after the gymnast performed a specific gymnastics skill, she viewed a video segment showing an expert gymnast performing the same skill and then viewed a video replay of her own performance of the skill. The results showed that all gymnasts demonstrated improved performance across three gymnastics skills following exposure to the intervention.

DESCRIPTORS: athletic performance, gymnastics, sport psychology, video feedback, video modeling

Behavioral procedures have proven to be effective in improving athletic performance across a diverse array of sports, including ballet (Fitterling & Ayllon, 1983), basketball (Harle & Vickers, 2001), tennis (Rikli & Smith, 1980), swimming (McKenzie & Rushall, 1974), football (Smith & Ward, 2006), and gymnastics (Wolko, Hrycaiko, & Martin, 1993). Two behavioral procedures used for improving skill execution are video feedback and video modeling by experts (Hazen, Johnstone, Martin, & Srikameswaran, 1990). Video feedback involves showing an athlete a video clip of his or her own performance of a particular skill (Hazen et al.), and video modeling involves presenting the athlete with a video clip of an expert performing the skill (Boschker & Bakker, 2002; SooHoo, Takemoto, & McCullagh, 2004; Winfrey & Weeks, 1993; Zetou, Tzetzis, Vernadakis, & Kioumourtzoglou, 2002).

The combined use of video modeling and feedback holds promise for improving the execution of complex athletic skills such as gymnastics routines that require multiple precise body movements and positions. Only two studies have examined the effectiveness of the combination of video feedback and video modeling by experts. Harle and Vickers (2001) helped basketball players improve eye gaze at the hoop to increase free-throw accuracy, whereas Rikli and Smith (1980) helped adult tennis players improve their serves. Because one study was conducted on a simple skill involving sustained eye gaze and the other study involved a group design that showed minimal effects, the effects of video feedback and video modeling by experts on complex athletic performance are not well established. The purpose of the present study was to examine the effectiveness of combining video modeling by experts with video feedback on the development of three complex gymnastics skills.

METHOD

Participants and Settings

Four female competitive gymnasts (7 to 10 years old), who had been receiving training from the same south Florida gymnastics club for the last few years, participated in the study. Each gymnastics practice was 3 hr in length, with approximately 30 min devoted to the skills included in this study. The intervention was

This study was conducted as a master's thesis by the first author.

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implemented during these regularly scheduled gymnastics practices three times a week.

Materials

The materials included two digital video cameras for recording the participant's performance and a laptop computer with software to display simultaneously the participant's performance clip and the expert model. Expert model clips of each of these three skills were selected from videotaped performances of USA national team members participating in the 2006 USA championships. The expert clips were selected by a USA Brevet gymnastics judge (the highest rating in the USA Junior Olympics program) in consultation with coaches of elite athletes and the coach assisting with this study. The skills were performed on a piece of gymnastics equipment called the uneven bars, which consisted of a metal frame supporting two parallel bars set at different heights. Colleen and Megan used a strap bar (the gymnast's hands are strapped to a single high bar to ensure safety) when learning "the giant," a routine that involves swinging 360 degrees around the bar in a handstand position.

Target Behaviors, Data Collection, and Interobserver Agreement

The target behaviors assessed in this study included a backward giant circle to handstand (i.e., a giant), a kip cast, and a clear hip circle. The kip cast and clear hip circle are both swings around the low bar ending in a handstand (complete definitions of all three target behaviors are available from the first author). Data were collected using a 28-item checklist for each skill, with each component scored as either correct or incorrect, resulting in a percentage correct for each trial. The experimenter recorded the first attempt to perform a skill in each set of uninterrupted repetitions, and graduate students trained by a USA Brevet gymnastics judge later scored the skill from the video.

One third of the assessment sessions were scored by two independent observers. The percentage of agreement was calculated by dividing the number of agreements for the 28 components of a skill by the number of agreements plus disagreements. Mean interobserver agreement percentages across baseline, intervention, and follow-up phases were as follows: 91%, 93%, and 95% for Becky; 92%, 93%, and 94% for Colleen; 91%, 91%, and 95% for Serena; and 91%, 94%, and 94% for Megan.

Design and Procedure

The effects of video modeling by experts and video feedback were evaluated in a multiple baseline across behaviors (Delano, 2007) design for each participant.

Baseline. Baseline data were collected for the three targeted skills under normal practice conditions. In baseline and intervention phases the experimenter asked the coach to continue his usual coaching procedures, which consisted of verbal feedback after the dismount from the apparatus.

Video modeling by experts with video feedback. After the gymnast performed the target skill, she walked to the computer, and the computer technician told her, "Try to match the expert gymnast on the left." The gymnast then viewed the left computer screen showing an expert gymnast performing the same skill followed by her own video performance on the right screen. Next, the gymnast viewed the two video clips side by side, and the technician freeze-framed each clip at five different points for that skill. The technician played the expert model of the skill again at normal speed, followed by the gymnast's own performance of the skill at normal speed. Each session lasted approximately 50 s. The gymnast then attempted the target skill two more times as she completed the set of three repetitions of the skill. The gymnast did not receive verbal feedback from the technician or any other research team member. The coach continued practice as usual, using verbal performance feedback without the video procedures.

Follow-up assessment. After the final intervention session for each target behavior, a follow-up session was conducted weekly without video modeling and feedback.

Social Validity Measures

Social validity was assessed following the study using questionnaires administered to the gymnasts, coach, and assistant coaches. The questionnaires used a 5-point Likert-type scale to assess how much they liked the procedure, whether they would recommend it to others, how easy it was, how helpful it was, and how effective it was in skill development. As another measure of social validity, three USA Brevet gymnastics judges scored two baseline video clips and two intervention clips for each skill (randomly selected from the second half of baseline and intervention for each skill) that each gymnast performed to simulate how the skills would be judged in competition and to determine if the improvements in skill performance between baseline and intervention would be corroborated by judges' scoring.

RESULTS AND DISCUSSION

Because the girls continued to receive coaching during baseline and some modest increases were noted in the longer baselines for some skills, the baseline means reported below consist of the last 12 data points from the longer baselines. The baseline, intervention, and follow-up means for Becky were 21%, 42%, and 52% for the clear hip circle and 57%, 68%, and 66% for the kip cast. The baseline, intervention, and follow-up means for Colleen (Figure 1) were 38%, 57%, and 49% for the kip cast; 25%, 49%, and 60% for the giant; and 35%, 43%, and 46% for the clear hip circle. The baseline, intervention, and follow-up means for Serena (Figure 2) were 51%, 69%, and 67% for the kip cast; 33%, 55%, and 58% for the clear hip circle; and 45%, 59%, and 52% for the giant. The baseline, intervention, and follow-up means for Megan (Figure 2) were 18%, 39%, and 56% for the clear hip circle; 26%, 48%, and 51% for the giant; and 67%, 73%, and 70% for the kip cast. The percentage increase over baseline was variable, ranging from 9% (Megan's kip cast) to 116% (Megan's clear hip circle), with a mean increase from baseline across girls and skills of 53%.

The social validity questionnaire results showed that the coaches and gymnasts, respectively, liked the procedure ($M = 4.33$, $M = 4.75$), would recommend it to others ($M = 4.67$, $M = 4.25$), thought it improved performance ($M = 4.33$, $M = 4.25$), and thought it was helpful ($M = 4.67$, $M = 4.75$) and easy to follow ($M = 4.0$, $M = 4.5$). The judges' scoring of baseline and posttraining video clips using standard gymnastics judging deductions showed small and varied improvements in the skills from baseline to intervention phases (contact the first author for details). However, the judges' scores indicated that the gymnasts' skills were still in the developmental stages even after intervention, and that their skills were not yet ready for competition at the conclusion of the study.

The results of this study indicate that exposure to the intervention improved skill performance more quickly than regular practice and coaching alone. These results suggest that adding video modeling by experts with video feedback to typical coaching and practice techniques could reduce the number of practice sessions required to improve a difficult physical skill. Follow-up measures demonstrated that, for the most part, the gymnasts maintained their higher level of performance even after the intervention was no longer available for that skill. In addition, social validity assessments showed that the procedure was well received by the gymnasts and coaches.

Although the video modeling and feedback intervention enhanced skill performance to above-baseline levels, near-flawless skill performance (80% to 100% correct) was seldom achieved by the gymnasts. Although these

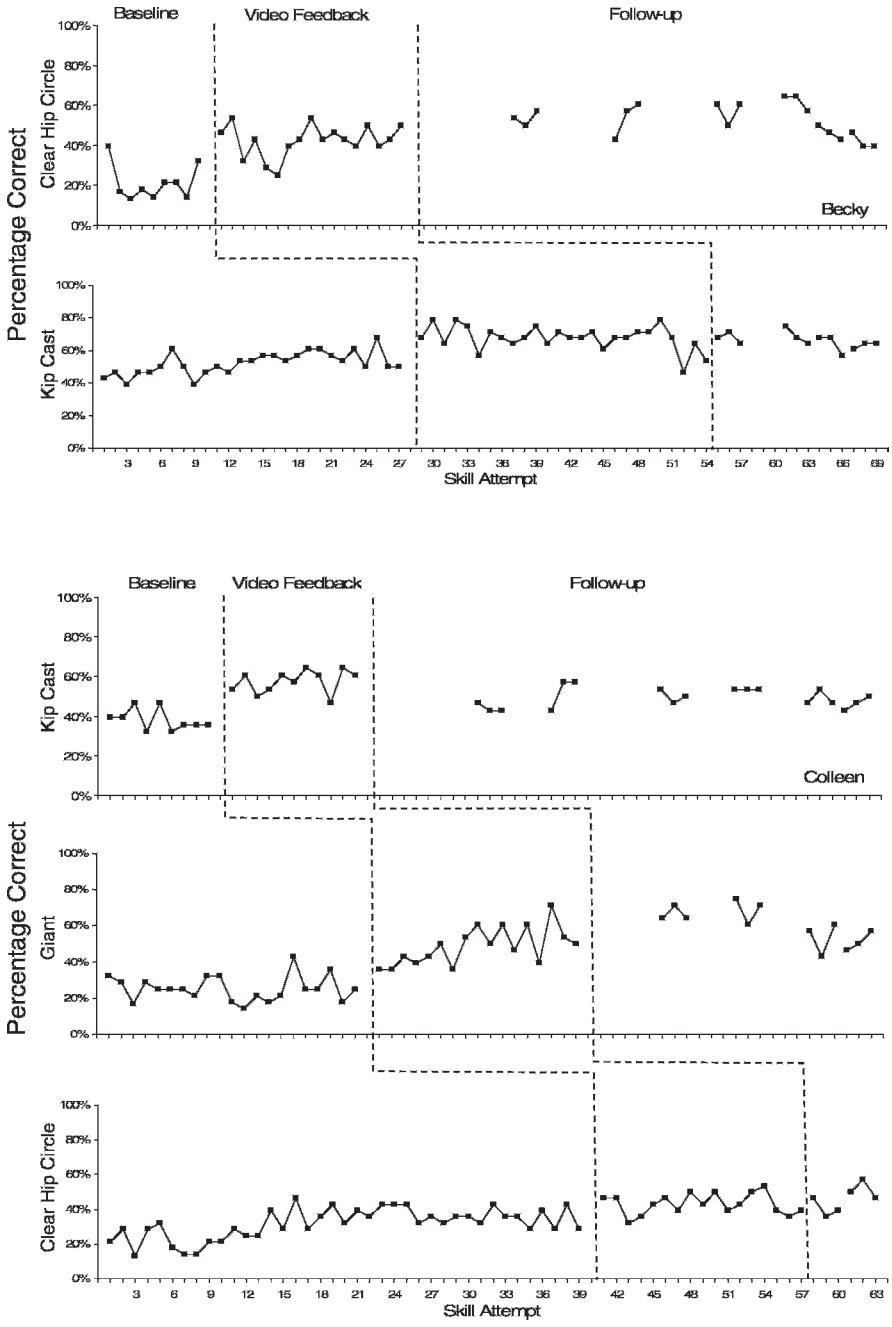

Figure 1. Percentage of correct skill performances across target behaviors for Becky and Colleen.

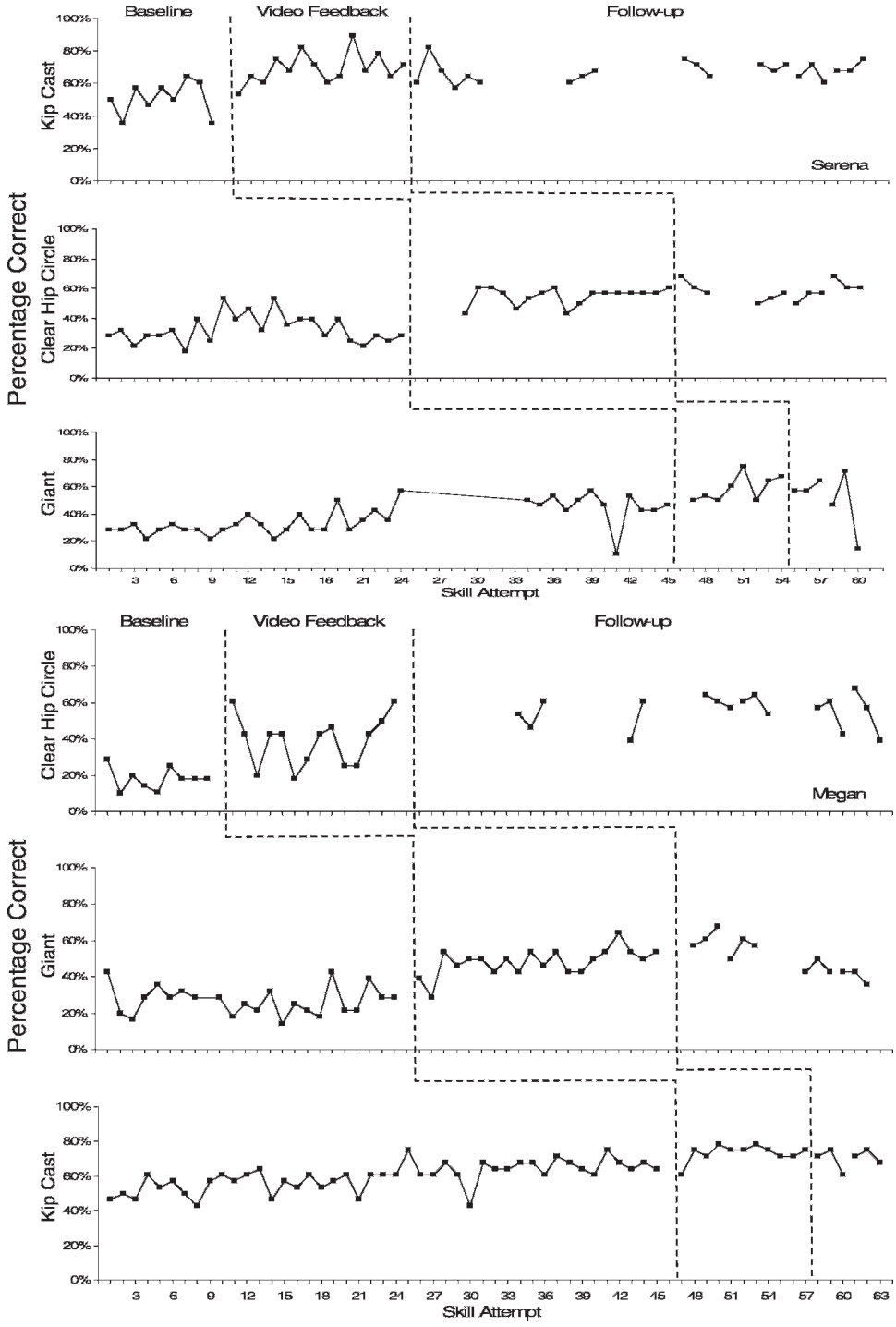

Figure 2. Percentage of correct skill performances across target behaviors for Serena and Megan.

results might seem disappointing and suggest that the intervention was not successful, it is important to view the results in the context of complex athletic skill development, which requires precise body movements and increasing strength over time. Scores near 100% accuracy would suggest flawless performance, something rarely achieved even by Olympics-caliber gymnasts. The findings add to the scant literature supporting the effectiveness and usefulness of the procedure (e.g., Harle & Vickers, 2001; Hazen et al., 1990; Rikli & Smith, 1980) and suggest its potential to enhance the effects of coaching across a variety of sports.

A few limitations are worthy of note. The freeze-frame images of the gymnasts were sometimes slightly blurred due to technical limitations of the cameras. In addition, the expert and novice gymnast clips could not run in perfect synchronization due to differences in the performance rates of the gymnasts. Future research that incorporates more advanced video technology might capture clearer body images and provide better opportunities for the gymnast to discriminate various elements of his or her body positions as correct or incorrect. Also, future research could analyze the effect of delayed video feedback after practice, using more precisely synchronized freeze-frame comparisons of the expert gymnast with the novice gymnast. Finally, some of the gymnasts developed injuries doing other skills, which may have to some degree impaired their performance of the skills being measured in this study. Although minor injuries often occur in athletic performance, they may influence the results in unforeseen ways.

We believe that video modeling by experts and video feedback for competitive gymnasts has the most potential to be effective for increasing the execution of a skill that has already been learned at a basic performance level, as was found by Rikli and Smith (1980). Future research needs to replicate this study with skills the gymnast has nearly mastered or performed in competition. In this way the athletes could focus more on fine discriminations in body positions and movements, without the additional task of learning the basic body movements of the skill.

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