2008

Expert video modeling with video feedback to enhance gymnastics skills

Eva Boyer
University of South Florida

Expert Video Modeling with Video Feedback to Enhance Gymnastics Skills

by

Eva Boyer

A thesis submitted in partial fulfillment
of the requirements for the degree of
Master of Arts in Applied Behavior Analysis
College of Graduate School
University of South Florida

Major Professor: Raymond G. Miltenberger, Ph.D.
Catherine Batsche, Ph.D.
Trevor Stokes, Ph.D.

Date of Approval:
March 27, 2008

Keywords: Sport, behavior, freeze frame, athletic performance, uneven bars

Acknowledgements

I wish to thank the members of my committee for their support and encouragement throughout this process. Dr. Miltenberger, thank you for providing the opportunity for me to pursue my goal of incorporating behavior analysis into the sport of gymnastics. Your dedication and commitment to helping your students succeed has been unwavering. Your guidance and support through this challenging process has been both calming and motivating. It has been a privilege to have you as my thesis advisor. Dr. Batsche, you have been a valued mentor and "judge" of my abilities to conduct this research in the sport of gymnastics. Thank you for so generously giving your time. Your understanding of competitive gymnastics and your enthusiasm for this research project helped motivate me to continue moving forward. Dr. Stokes, you have been a wonderful teacher, your wisdom and your words (skeptical and critical) have had a lasting effect on me. With your help I have become skeptical enough to occasionally question even my own assumptions and critical enough to recognize many of the possible confounding variables related to my research study. I would also like to thank Stacie Neff. If this amazing lady had not been involved, I believe my relocation to Florida and my graduate studies at the University of South Florida would not have been successful. As well, I must thank my committed research assistants, Victoria Fogel, Lela Taylor and Sarah Mele for helping to make this thesis a reality.

Table of Content

List of Figures

Expert Video Modeling with Video Feedback to Enhance Gymnastics Skills

Eva Boyer

ABSTRACT

In an effort to develop more efficient and practical interventions for athletic performance, some behavioral researchers have incorporated a variety of technological innovations. In sports research, only a few studies have examined the effects of video feedback on athletic skill development. The effects of combining expert video modeling with self video feedback as an adjunct to standard coaching techniques were analyzed in this study. Participants in this study were four 7-10 year old competitive gymnasts. During the intervention, each gymnast performed a specific gymnastics skill and then viewed a pre-recorded video segment showing an expert gymnast performing the same skill. The gymnast then viewed a video replay of her own performance of the skill. Next she saw a side by side slow motion with freeze frame comparison of her performance with that of the expert model. Lastly, in normal time, the gymnast viewed the expert video clip again, followed by her own performance of the skill. The effect of expert video modeling with self video feedback on gymnastics skill performance was evaluated in a multiple baseline across behaviors research design. The results showed that the gymnasts' skills increased in performance following exposure to video feedback.

Chapter One

Introduction

Research using Applied Behavior Analysis (ABA) methods to enhance athletic performance has been conducted for over 30 years. In 1974, the *Journal of Applied Behavior Analysis (JABA)* published the first sports-related behavioral research study. In this early study, researchers McKenzie and Rushall used self-monitoring and feedback to improve the performance of competitive swimmers. In 1977, Komaki and Barnett used a verbal checklist review and feedback following football plays to improve different targeted play performances. In 1980, Allison and Ayllon coined the term "behavioral coaching," and applied this structured intervention across three different sports. Allison and Ayllon (1980) demonstrated that a behavior coaching package increased correct performance of targeted sport skills in football, gymnastics, and tennis. Over the ensuing years, numerous ABA procedures have been applied to various sports. Behavioral researchers have refined skill training methods into more structured feedback processes which identify target responses and include operationally defined protocols for presenting feedback. In addition, researchers have made modifications to both systems of instruction and reinforcement strategies by including modeling, error correction, and/or selective praise with many different sports including ballet (Fitterling & Ayllon, 1983), basketball (Kladopoulos & McComas, 2001), inline roller speed skating (Anderson & Kirkpatrick, 2002) and tennis (Buzas & Ayllon, 1981). Self-monitoring is another interesting behavioral strategy in which the participants view their own progress by analyzing their

own data on targeted behaviors. A variety of self-monitoring strategies such as publicly posting athletic performance data versus private posting have been compared in the sports such as swimming, gymnastics, and football (McKenzie & Rushall, 1974; Smith & Ward, 2006; Wolko, Hrycaiko, & Martin, 1993).

One ABA procedure that has demonstrated effectiveness in improving skill execution is the use of video for performance feedback and expert modeling (Hazen Johnstone, Martin, & Srikameswaran, 1990). Video feedback involves showing a recorded video clip of an athlete performing a particular skill or component of a skill to that athlete while video modeling shows the athlete a video of an expert performing the skill. During the past 20 years, video recording technology has improved substantially. However there have been relatively few behavioral research studies utilizing these newer technological tools in sports' interventions (Hazen et al., 1990; Scott & Scott, 1997; Ziegler, 1994).

Video Feedback and Rehearsal Package

In 1990, Hazen et al. conducted two experiments on the effects of videotaped feedback and modeling on racing turn performance of swimmers. The participants in these experiments were a group of 8-12 year old competitive swimmers. In experiment one, researchers calculated the percentage of correct freestyle flip turns and the percentage of correct backstroke turns. The intervention involved a videotaping package that included modeling, role-playing, symbolic modeling, instructions, videotaped feedback, and verbal feedback. If the swimmer was working on the back stroke spin, the coach instructed and modeled the correct position while lying on the pool deck. The swimmer then role played the turn on the pool deck. In addition to the modeling and

role playing, the subjects watched a videotape of an expert perform the turn correctly (symbolic modeling) as an instructor verbally highlighted relevant components of the turn. In the pool, the swimmer then performed two turns and was immediately provided with self video feedback on a color monitor. While the swimmer viewed his or her turns on the video tape, a trainer provided verbal positive feedback for the correct turn components and corrective feedback for incorrect turn components. Videotape feedback was provided within each session and training sessions continued until the swimmer reached a set criterion for the skill. Results from experiment one showed an increase in the percentage of correctly executed freestyle flip turns from baseline levels of 60-80% to intervention and maintenance levels of 80-100%. The percentage of correctly executed backstroke turns also increased following the intervention.

The second experiment conducted by Hazen et al. (1990) monitored the percentage of correct freestyle stroke components following the intervention of reviewing self video tape performance in a group and then individually. In baseline, participants were at near zero levels of percent correct freestyle components. Following the intervention, participants' scored in the 60-100% range of correct freestyle components. Generalization sprint trials showed that participants who received individual review of their tapes had better time performances in comparison to participants who received only group videotape exposure. In the future, a component analysis of this intervention package would be useful to identify which of the components in the intervention package were actually responsible for the observed improvements.

Self-video Modeling

Since the study by Hazen and colleagues in 1990, a handful of other studies have evaluated video modeling and video feedback to improve athletic performance in a variety of sports. In 1993, Winfrey and Weeks studied the effects of self-modeling (videotape feedback) on a gymnast's ability to estimate her beam routine score. Gymnasts between the ages of 8 and 13 participated in the study. The participant's beam routine performances were videotaped and later scored by judges. Before each practice, the gymnast viewed the edited videotape of her own successful beam routine performance. Results indicated that following exposure to the self-modeling videotape intervention, gymnasts were more accurate at estimating their next beam scores. A limitation to the study may include the use of potentially subjective judge's scores as a dependant variable. Future research may examine the use of checklists or some other method of more objectively measuring performance. Future studies could examine the effects on performance of viewing videotapes of expert athletes performing specific skills.

Ziegler (1994) also evaluated the effects of video feedback during attentional shift training on the execution of soccer skills. In this study, soccer players were trained to respond to different external stimuli (i.e., position of ball, teammates, and opponents). A multiple baseline design across four male collegiate soccer players was used to examine the effectiveness of an attention training program on the execution of targeted soccer skills. Subjects were exposed to information and laboratory attentional shift exercises followed by practice of accuracy of execution of different soccer activities. During the attention shift exercises, participants viewed videotapes of past games. The

use of attentional shift training with video feedback resulted in an improvement in execution of soccer skills. The study results also revealed increases in the number of points scored following the completion of the attentional training intervention.

Video Modeling Strategies

In addition to the use of video to provide performance feedback on athletic performance, video has also been used to provide expert modeling (e.g., Hazen et al., 1990). In 1998 Scott, Scott, and Howe tested the effects of video modeling on adult tennis players' ability to return tennis serves. Participants viewed a film of a person serving and were asked to describe it verbally (type, depth and landing). Subjects were then requested to physically model the correct tennis stroke return. When a subject's performance scores reached criterion (75% correct or 45 points out of 60) the participant progressed to the next session and the speed of the video was gradually increased. This intervention resulted in a measured increase of 10 points earned on court serves and returns compared to baseline scores. Although the study used only an AB design, the positive results of this study suggest that video modeling is a promising approach and should be further evaluated in additional sports performance research.

A variety of other studies have evaluated video modeling for improving athletic performance. In 2002, Boschker and Bakker investigated the effects of observing a video of an expert wall climbing, a novice wall climbing or just observing the wall on video. Undergraduate students were separated into the three conditions and measurements of percentage of a successful climb and duration of a climb were recorded. Participants who received a video performance of a model (novice or expert) had faster and more fluent climbs. The participants in the novice video condition demonstrated the greatest time

reductions to climb the 7meter wall. Unfortunately participants in each condition observed a different climbing technique. Future studies should use videotapes of expert and novice climbers performing the same wall climbing skills.

In 2004, SooHoo, Takemoto, and McCullagh investigated the effects of modeling and imagery on motor performance. University students were placed in a modeling or imagery condition. Before each trial of free weight squat lifts, subjects participated in the training protocol for their group. The modeling group watched a video of an expert performing free weight squat lifts before each trial and the imagery group listened to an audio tape instructing the participant how to visualize performing a squat lift before each trial. Pre to post test assessments demonstrated that both modeling exposure and imagery exposure resulted in an improvement in body form execution and the number of squats in a set time (15 seconds). Future research could investigate the participant's preference for either the modeling or imagery intervention.

With video feedback and video modeling both established as effective procedures for enhancing athletic performance, some researchers have compared the effectiveness of the two procedures. In 2002, Zetou, Tzetzis, Vernadakis, and Kioumourtzoglou examined the effects of expert modeling versus video feedback (called self modeling) on volleyball skills. The subjects, children ages 11-12, watched a video of either an expert performing several volleyball skills (expert modeling group) or a video taken of themselves serving (self modeling group). Participants in the expert modeling condition demonstrated more improvement in a variety of volleyball skills (set and serve score/form) than did the self modeling group. However, the self modeling participants' serve scores were slightly higher than the expert modeling participant scores. This study had participants view the

expert model tape in a large group, while self model participants were able to view their tapes individually. Future research should attempt to control these types of extraneous variables or perhaps directly measure their effects on performance.

Video Modeling and Video Feedback

In one study, video modeling and video feedback were combined. In 2001, Harle and Vickers studied the effects of quiet eye training on university level basketball free throw shooting. Participants received video feedback on their eye gaze. Participants reviewed their quiet eye (player's final glaze on hoop area) data in comparison to a video of an expert's eye gaze. Subjects were taught a three step routine (stance, hold, shoot) during a feedback session and later on the basketball court. Results demonstrated that training a sustained duration of gaze on the hoop prior to the execution of a shot can improve free throw performance.

The Present Study

During the last fifteen years, substantial improvements in technology have occurred. As ABA researchers attempt to improve more complex forms of human behavior, the availability of new tools for recording and measuring behavior could present opportunities to enhance interventions. Many recently developed tools, such as high resolution digital video cameras, may have considerable potential in sport interventions. Recent research has shown that both viewing video feedback and observing videotapes of an expert model can result in improved athletic skill performance. Several studies have examined the effects of viewing video clips of an athlete's own performance (video feedback), while other studies have examined the effects of viewing video clips of an expert model's performance (expert video modeling).

A few studies have attempted to compare these two strategies. However, only one study published to date has examined the effectiveness of simultaneously presenting athletes with video feedback and expert video modeling (Harle & Vickers, 2001). Harle and Vickers evaluated the effectiveness of an intervention in which basketball players compared their eye gaze during their own free throw shooting to the eye gaze of experts.

The present study expanded the use of expert video modeling with video feedback to three complex athletic skills involved in gymnastics routines. This type of study has implications for the inclusion of these two strategies in ABA interventions designed to help people improve many other types of skilled physical movements. If young gymnasts improve skill performances or learn difficult skills more quickly when exposed to the video feedback intervention, then perhaps expert video modeling with video feedback could be adapted for teaching a wide variety of skills.

In this research study, each athlete viewed a laptop screen which showed two side by side video clips. The left side of the screen played a video clip of an expert gymnast performing a skill and the right side replayed the gymnast's own recent performance of the same skill. Each side of the screen presented a video image that was as similar as possible to the other, i.e., the expert gymnast performed the same skill from the same direction as the novice gymnast. This arrangement permitted each young gymnast to quickly and directly compare her recorded performance to that of the expert model. Slow motion with freeze frame pauses were used to enhance the gymnast's opportunity to compare and contrast her performance with that of the expert. The purpose of the present study was to examine the effectiveness of combining expert video modeling with video feedback on the development of three specific gymnastics skills.

Chapter Two

Method

Participants and Settings

Four female competitive gymnasts, 7 to 10 years of age, participated in the study. The study originally included five participants, however due to an injury unrelated to the research study, one gymnast did not participate in the study. All participants attended the same South Florida gymnastics club three days per week. Each gymnastics practice was three hours in length with approximately thirty minutes devoted to practice on the skills included in this study. The intervention (expert video modeling with self video feedback) was implemented at this facility during these regularly scheduled gymnastics practices.

Recruitment Method. Prior to conducting this research, the author consulted a highly qualified gymnastics judge. This judge introduced the author to a gymnastic center that was interested in pursuing new gymnastics training strategies. The author then made frequent visits to this gymnastics center and developed a rapport with the management, coaches and gymnasts. During these visits, the author and coach discussed coaching strategies, training techniques, and the difficulties young gymnasts typically experienced when learning specific skills. In consultation with the coach, the author developed the video feedback strategy that was compatible with the coach's training methods.

Participation Consent. This study received Institutional Review Board approval in the fall. Parental consent and gymnast assent forms were included in the application. The author provided the coach with a letter inviting the gymnasts' parents to a meeting

with the author. The purpose of this meeting was to describe the proposed research and specifically the video feedback intervention. All parents were encouraged to attend the meeting and the gymnasts were also welcome. Many of the gymnasts attended with their parent. During this meeting, the author provided a brief explanation of her study, presented an example of the video feedback intervention on her laptop computer, and reviewed the parent consent forms. During the consent meeting a well respected judge, involved in the development of the author's study, was also available for questions. Parents and gymnasts were also informed that the gymnasts' video tapes and names would remain confidential. Parental consent forms were available for signing and parents were informed that they also had the option of submitting the forms at a later date.

Prior to recording the first baseline video clip, verbal assent was obtained from each gymnast. The researcher read an assent script to each gymnast which included a statement confirming that the gymnast's parent had agreed to their participation in the study. Each gymnast was informed that she could chose not to participate in this study and still continue with her normal practice if she wished. The gymnasts' real names were not used in this study. Fake names were provided for each gymnast.

Materials

The materials included 2 digital video cameras for recording the participants' performance and a laptop computer with software to provide the audio instructions and display the 2 video clips. Two cameras were only used for time efficiency purposes. One camera would input the video feedback clip into the laptop computer while the other camera continued recording the other gymnasts' baseline and follow-up skills. The laptop computer presented one clip of the gymnast performing a skill and the other clip

displayed the expert model's performance of the same skill. Expert model skill clips of each of these three skills were selected by a USA Brevet gymnastics judge (the highest rating in the USA Junior Olympic program). From this group of expert video clips, the coach chose one model video clip per skill that best demonstrated the techniques he wanted his gymnasts to use to perform the skill. The skills were performed on a piece of gymnastics equipment called the uneven bars. This apparatus consists of a metal frame supporting two parallel bars set at different heights. The low bar was set at a height approximately 5ft above the floor and the high bar was approximately 8ft above the floor (standard uneven bar setting). The distance between these two bars, called the span distance, is adjustable and was set at approximately 6 ft.

Two participants (Colleen and Megan) used a strap bar rather than the standard uneven bars when learning the giant. This strap bar was a single metal high bar, rather than the typical pair of wooden uneven bars. The gymnast's hands were strapped to the bar to ensure safety while learning how to circle around the bar in a handstand position. This "strap bar" prevented the gymnasts from falling off the bar while learning this difficult skill. Although these two gymnasts performed the giant on the "strap bar" during the baseline and intervention phases of the study, the two first giants during the follow-up sessions were performed on a single wooden bar with physical guidance by a coach. The gymnasts performed the last two giants in the follow-up sessions on the strap bar. Therefore for these two gymnasts, baseline, intervention and the last two follow-up session giants were all performed on the same apparatus, namely the strap bar.

Target Behaviors and Data Collection

The target behaviors assessed in this study were three specific gymnastics skills performed on the uneven bars. The skills included a backward giant circle to handstand, a kip cast, and a clear hip circle. A giant circle to handstand is a swing on the high bar in which the body is fully extended and rotates 360 degrees around the bar. In this study, the kip cast and clear hip circle were both performed on the low bar. The kip cast is a two skill combination. The kip is a move from a standing position on the floor to a glide swing below the bar and finally to a position above the bar. The gymnast begins this skill standing on the floor facing the low bar. She then jumps forward, grasps the low bar, swings forward beneath it, bends at the hips bringing her legs near the bar, and swings back under the bar. Momentum generated from the kip then moves the body into a cast above the bar, ideally to the handstand position (vertical). If the handstand position is reached, the gymnast's body is now upside down and vertical and she is supported only by her arms with both hands gripping the bar. The minimum cast requirement for these gymnasts was reaching a cast of 45 degrees from vertical. The clear hip circle begins with a body circle around the bar, with the hips a few inches away from the bar, and ends in a handstand position on the top of the bar. This skill also required the gymnast to reach the same minimum height of 45 degrees from vertical. The gymnast, in the expert video clip, performed each of these target skills and reached a vertical handstand position above the bar. See Appendix A for operational definitions of the components of each target behavior. See Appendix B for a detailed description of each gymnastics skill.

The primary data collection tool was a checklist designed for each of the target behaviors. Each checklist contained 5 specific phases, numbered 1 through 5, which

were required to perform that skill. Each phase of a skill contained 5 to 7 components that were observed and scored. The checklist for each skill included 28 components which were scored as either correct or incorrect for each trial. The gymnast's performance of the target skill was video recorded during her regular training regime. These gymnasts typically practiced a skill by performing it 6 consecutive times (a set of 6), then took a break and repeated this procedure (i.e., they completed 3 sets of 6 repetitions). The first attempt to perform a skill in each set was video recorded and scored. Each gymnast's score (percentage correct) was computed by dividing the total number of correct components by the total number of components observed (28) and then multiplying the dividend by 100. The first attempt to perform the skill (i.e., the first giant out of a set of six), was video recorded as a trial. The trials were observed and scored from videotape by trained ABA graduate students. These observers were trained by a gymnastics judge (who held a USA Brevet rating) to score each component of a skill according to specific criteria. Each observer achieved a minimum of 80% agreement with the USA Brevet gymnastics judge during the observers' training period. The trained observers also achieved the requirement of a minimum of 80% agreement with each other before they scored baseline or intervention sessions.

Inter-observer Agreement

One third of the video sessions were scored by two independent observers. The percentage of agreement was calculated for each observation by dividing the number of agreements for the 28 components of a skill by the number of agreements plus disagreements. Percentage of agreement for each observation in baseline, intervention

and follow-up was averaged to produce a mean for baseline, intervention and follow-up phases per gymnast.

Social Validity

Social validity was assessed using two questionnaires (Appendix C: Social Validity). Following the completion of the study, one questionnaire was administered to the gymnasts and a separate questionnaire was administered to the gymnasts' coach and assistant coaches. The assistant coaches occasionally assisted during bar practices. However, the coach selected the skills and training techniques to be used during each bar practice. A research team member verbally reviewed each question with each gymnast and asked if they had any questions. Both the gymnasts and coaches were asked to answer the questionnaires independently and return them to the researcher at the next practice. The questionnaires were intended to measure the appropriateness of the procedures, the social importance of the goals and the social importance of the effects.

Another separate measure of validity was conducted after the study had been completed (Appendix D: Gymnastics Judging Procedure). Three highly qualified gymnastics judges (USA Brevet ratings) scored a random sample of video clips consisting of two baseline and two intervention clips for each skill that each gymnast performed in the study. This procedure was intended 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. The judges were not aware if the clips they were scoring were recorded during the baseline or intervention. These clips were randomly selected from each gymnast's second half of baseline and second half of intervention for each skill. The video clips were randomly selected using

the “pulling numbers from a hat” procedure. For viewing purposes, the selected clips were then arranged by duration, shortest to longest.

Procedure

A multiple baseline across behaviors research design was used to evaluate the effects of the intervention. Although each gymnast received video feedback for each of the 3 targeted skills, the gymnasts received video feedback for each of the three skills in one of three different orders. For example, after baseline measures were complete, Becky received the video feedback intervention first following her performance of the clear hip circle. Meanwhile her teammate, Serena, received video feedback first following her performance of the kip cast.

Baseline and intervention data were collected for the three target behaviors performed by each participant. The gymnasts were presented with the intervention for only one skill at a time. The implementation of the intervention (expert video modeling with self video feedback) was staggered across time for each of the three behaviors (skills). The same intervention procedure was implemented for each behavior.

Baseline. Baseline data collection for the three targeted skills occurred under normal practice conditions. During baseline conditions, the coach was asked to continue his usual coaching procedures. For each gymnast, at least nine stable data points were collected across 3 separate practice sessions before intervention exposure (video feedback).

Expert video modeling with self video feedback. During the intervention phase, after the gymnast performed the target skill she received audio instructions to “Please watch these two video clips carefully. Notice how your skill is similar or different from

the expert gymnast on the left. When you do this skill again try to copy the expert gymnast." These instructions were later (after two intervention days) reduced to a simple verbal instruction by the laptop technician, "try to match the expert gymnast on the left." The instructions were modified in response to the coach's concern of time efficiency. After the instructions were presented, the gymnast then viewed the left side laptop screen showing of an expert gymnast performing (modeling) the same skill and then viewed her own video performance on the right side screen. Next the gymnast viewed the two video clips side by side and each clip was freeze framed at each of the 5 phases for that skill. The expert model clip of the skill was played back again at normal speed followed by the gymnast's own performance of the skill at normal speed. During the video feedback session the laptop technician navigated the controls on the laptop to show the gymnast the appropriate clips. The gymnasts independently viewed the clips and then went back to the bar to perform the skill again. No verbal feedback was provided to the gymnast on her target skills by the laptop technician or any research team members. The coach was instructed not to participate in the video feedback and to continue coaching practice as usual.

During each practice session, a gymnast performed three attempts of the targeted skill. An attempt of a target skill was defined as the first skill a gymnast performed in a set. For example, if a gymnast was practicing "giants," the first giant out of a continuous set of 6 giants was counted as the attempt. It was that first giant that the observers scored and it was that first giant the gymnast reviewed on the laptop right side screen. If a gymnast received the expert video modeling with video feedback intervention for a target skill, the gymnast immediately received the intervention following the performance of

that skill set. If the gymnast had just performed a set of six giants, and was in the intervention phase for that skill, the gymnast immediately went to the laptop screen and received the expert video modeling and self video feedback for her attempted skill (the first giant in that set of six).

It is important to note that some participants used an easier bar for giants, i.e. these gymnasts hands were strapped to the bar to ensure safety when learning this skill (Colleen and Megan). For a gymnast that practiced her giant on the easier bar, she was shown the first attempt at normal speed and if she had not completed the first giant circle around the bar, she was also shown the next giant in that same set, one in which she actually completed the whole circle around the bar. For video feedback purposes, the first strap giant completed around the bar was the giant viewed for the side by side comparison. This way the gymnast could view all phases of her skill in comparison to the expert. Although a gymnast may have viewed a freeze frame of her second swing, the observers always scored the first attempt of the skill in the set, that is to say if the gymnast only made it half way around the strap bar on her first attempt and then swung completely around the bar on her second attempt, it was the first attempt that was scored. Two gymnasts, Colleen and Megan, performed the giant on the strap bar during both the baseline and intervention phases for that skill. During the first two giant follow-up sessions, the coach had these two gymnasts perform the skill with spot (physical guidance) on a single bar which is considered an easier method of performing the skill. The last two giant follow-up sessions were also performed on the strap bar. Therefore for these two gymnasts, baseline, intervention and the last two follow-up session giants were all performed on the same apparatus, namely the strap bar.

Consistent with a multiple baseline across behaviors design, following the establishment of stable baseline data, each target behavior (gymnastics skill) received the intervention. The gymnast received the intervention for a particular skill until a number of consecutive stable data points were recorded. On average, intervention for one skill was conducted across 6 consecutive gymnastics practices. The skill was then moved into the follow-up phase of the study and the gymnast received the intervention for a different skill.

Follow-up assessment. One week after the final intervention session for each target behavior, a videotaped follow up session was recorded and scored. This assessment was conducted in the same manner as the baseline and intervention phases of the study. Each gymnast's performance of the 28 components in each of three gymnastics skills was scored from video clips using the same checklists used during the baseline and intervention phases. The follow-up assessment was conducted over a two to three week period (one assessment per week) following the termination of the intervention phase for that skill. As in the baseline and intervention phases, the same 28 components of each of the three skills were videotaped and scored.

Chapter Three

Results

The results demonstrated that after receiving the intervention each participant's gymnastics skills improved in comparison to baseline measures. The participants received the intervention, expert video modeling with video feedback, in addition to their regular practice and coaching procedures. It was assumed that skill levels would improve over the course of the study because the participants practiced many hours each week and worked with an experienced coach. This study investigated whether coaching plus the video-feedback intervention resulted in greater skill development than coaching and practice alone. A multiple baseline design across behaviors was employed to test this research question. Three behaviors (uneven bar skills) were evaluated for each of the four gymnasts who participated in this study. Results are shown in figures 1-4 and the means for each skill calculated from baseline and intervention are also provided. A fifth gymnast's data were not included because an injury, unrelated to the research, prevented her from completing the intervention phase of the study.

Following intervention, (expert video modeling with video feedback), each gymnast's performance of that skill improved. Specifically each gymnast's mean percentage correct for that skill increased from relatively low baseline levels to consistently higher levels following exposure to the intervention. This study reports two types of baseline means, total baseline mean and the end of baseline mean. The total baseline mean is the average percentage of correct skill performance found across all

baseline measures, from the beginning of the study until intervention for that skill. The end of baseline mean is the mean percentage found across the last twelve baseline measures (four gym practices) preceding intervention. The end of baseline mean was calculated because the moderately increasing trends during long baselines resulted in different levels at the end of baseline compared to the beginning of baseline for some skills. The last two skills that received intervention are discussed with both the total baseline mean and the end of baseline mean. The last two skills that received intervention have moderately different total baseline and end of baseline means in some cases because the skill had increased over the time due to the coaching each gymnast was receiving and to practice effects.

In figure 1, Becky's skill performance percentages are presented. Her clear hip circle scores increased from a baseline mean of 21% to a mean of 42% correct following exposure to the video feedback intervention. Follow-up measures indicated that her improved performance scores were maintained at 52%. Becky's performance on her kip cast had a total baseline mean of 52%, an end of baseline mean of 57%, and an intervention mean of 68% correct. Follow-up measures showed that the gymnast's skill performance was maintained at 66% following the removal of the intervention. Becky did not receive video feedback intervention for her third skill, the giant, due to coach and gymnast decisions that were unrelated to the research study.

In figure 2, Colleen's skill performance percentages are presented. Her kip cast scores increased from a baseline mean of 38% to a mean of 57% correct following exposure to the video feedback intervention. Follow-up measures indicated that her improved performance scores were maintained at 46%. Colleen's performance on her

giant had a total baseline mean of 25%, an end of baseline mean of 25%, and an intervention mean of 49% correct. Follow-up measures showed that the gymnast's skill performance was maintained at 60% following the removal of the intervention. Colleen's clear hip circle had a total baseline mean of 32% correct, an end of baseline mean of 35%, and an intervention mean of 43% correct. Follow-up measures also demonstrated that her skill performance for the giant was maintained at 49% following the removal of the video feedback intervention.

In figure 3, Serena's skill performance percentages are presented. Her kip cast scores increased from a baseline mean of 51% to a mean of 69% correct following exposure to the video feedback intervention. Follow-up measures indicated that her improved performance scores were maintained at 67%. Serena's performance on her clear hip circle had a total baseline mean of 33%, an end of baseline mean of 33%, and an intervention mean of 55% correct. Follow-up measures showed that the gymnast's skill performance was maintained at 58% following the removal of the intervention. Serena's giant had a total baseline mean of 37% correct, an end of baseline mean of 45%, and an intervention mean of 59% correct. Follow-up measures also demonstrated that her skill performance for the giant was maintained at 52% following the removal of the video feedback intervention.

In figure 4, Megan's skill performance percentages are presented. Her clear hip circle scores increased from a baseline mean of 18% to a mean of 39% correct following exposure to the video feedback intervention. Follow-up measures indicated that her improved performance scores were maintained at 56%. Megan's performance on her giant had a total baseline mean of 27%, an end of baseline mean of 26%, and an

intervention mean of 48% correct. Follow-up measures showed that the gymnast's skill performance was maintained at 51% following the removal of the intervention. Megan's kip cast had a total baseline mean of 60% correct, an end of baseline mean of 67%, and an intervention mean of 73% correct. Follow-up measures also demonstrated that her skill performance for the giant was maintained at 70% following the removal of the video feedback intervention.

As predicted by the author, some of the skills demonstrated a slight upward trend in baseline, although they remained relatively stable within a 20% range. Following intervention all of the skills increased and many of the skills had a greater slope (i. e., upward trend) than in baseline. In particular, Colleen's giant, Serena's kip cast and Megan's clear hip circle all have steeper upward trends following exposure to the video feedback compared to these skill's baseline trends. Follow-up measures showed that some of these upward trends continued, whereas for other skills, the percentage of correct skill performance was maintained at the same level following the intervention. Although many skills showed increases in percentage correct during follow-up, for some skills final follow-up sessions showed decreases in comparison to the previous follow-up measures (See Figure 1 - Becky's clear hip circle, Figure 2 - Colleen's giant, Figure 3 - Serena's kip cast and Figure 4 - Megan's giant). The last two measures of follow-up video were separated by a week with no video taping. The gymnastics environment may have changed. During that two week period the gymnasts may have practiced the skills less or were coached differently in comparison to the previous months.

Inter-observer Agreement

One third of the video sessions across baseline, intervention and follow-up phases were scored by two independent observers. Each skill was attempted three times during each day's practice session. Inter-observer agreement measures were calculated on the first attempt of each skill, during baseline, intervention and follow-up.

The percentage of agreement was calculated for each observation by dividing the number of agreements for the 28 components of a skill by the agreements plus disagreements. Percentage of agreement for each observation in baseline and intervention was averaged to produce a mean for baseline and for intervention phases. Follow-up inter-observer agreement was also calculated using the same procedure as in baseline and intervention. The first recorded attempt of the follow-up skill was scored with another observer for inter-observer reliability purposes.

The mean percent of inter-observer agreement score for the measured dependant variables for each of the gymnasts ranged from 82% to 100%. A total inter-observer mean of 92.8% was calculated across all gymnasts' inter-observer means. Becky's inter-observer agreement percentages included a baseline mean of 91%, an intervention mean of 93% and a follow-up mean of 95%. Colleen's inter-observer agreement percentages included a baseline mean of 92%, an intervention mean of 93% and a follow-up mean of 94%. Serena's inter-observer agreement percentages included a baseline mean of 91%, an intervention mean of 91% and a follow-up mean of 95%. Megan's inter-observer agreement percentages included a baseline mean of 91%, an intervention mean of 94% and a follow-up mean of 94%.

Social Validity Ratings

The post intervention social validity questionnaires were administered to the gymnasts, the coach and the assistant coaches. The questionnaire results from the four gymnasts, the coach and the two assistant coaches are presented in Appendix C: Social Validity. Overall, the gymnasts agreed that the video feedback technique was helpful and that their skills improved as a result of their participation in the study. One gymnast marked that she did not know if the video was easy to follow and another marked that she did not know if the video feedback helped her change her skill to look more like the expert gymnast. All gymnasts reported that they liked the video feedback and that they thought their skill(s) improved after watching the video.

The coach and two assistant coaches also completed a social validity questionnaire. The coach more strongly agreed with the video feedback technique than the assistant coaches. It is important to note that before the study was proposed, the author and the coach worked together to develop an intervention strategy that would be consistent with the coach's training methods. The coach strongly agreed that the video feedback package improved the gymnasts' skills and that the gymnasts changed their skills to look more like the expert gymnast. The coach commented that video feedback would be easier to add to practice if a larger viewing screen was available to the gymnasts, as well as to other observers in the gymnastics center. The two assistant coaches also agreed the gymnasts' improved their skills with the addition of the video intervention. Again, it was the coach that set the expectation for what these gymnasts were practicing, not the assistant coaches. The assistant coaches would occasionally be present to supervise the bar practices when the coach was busy working with other

gymnasts or the when the coach requested additional spotting assistance. One assistant coach selected a neutral response to the question if the video feedback procedure was easy to add to the gymnastics practice. The coach and both assistant coaches reported they would recommend the video feedback package to other gymnasts and coaches.

The gymnastics judges' scoring procedure, as explained by a gymnastics judge official who holds a USA Brevet rating, is listed in Appendix D. The judges scoring of the gymnasts' giant reflected improvement following the video feedback intervention. The judges also noted improvements in clear hip circle skills during the video feedback phase. However the judges scored slightly more deductions for kip cast skills during the video feedback intervention than in baseline. It could be argued that for this skill the gymnasts did not focus on their form as they were attempting to reach a vertical handstand. The scoring procedure in the study was weighted heavily for achieving closer approximations to a vertical position (i.e., successfully perform the new skill), whereas the competitive gymnastics judges scoring was weighted more heavily to form (i.e., body position errors). It is generally recognized that when gymnasts are attempting a difficult new skill, their form may initially deteriorate. The behavior checklist used by the author provided more opportunities for cast and form correctness, which may partly explain the difference in the kip cast performance as scored by the judge's ratings versus the researchers.

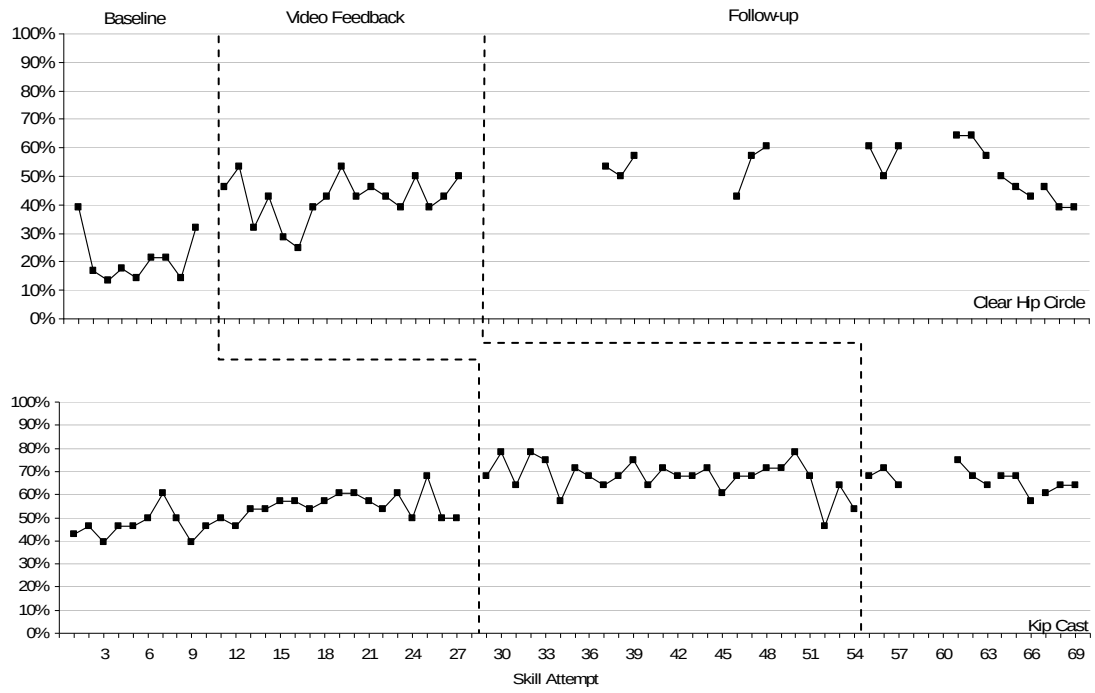

Figure 1. Multiple baseline across behaviors for Becky

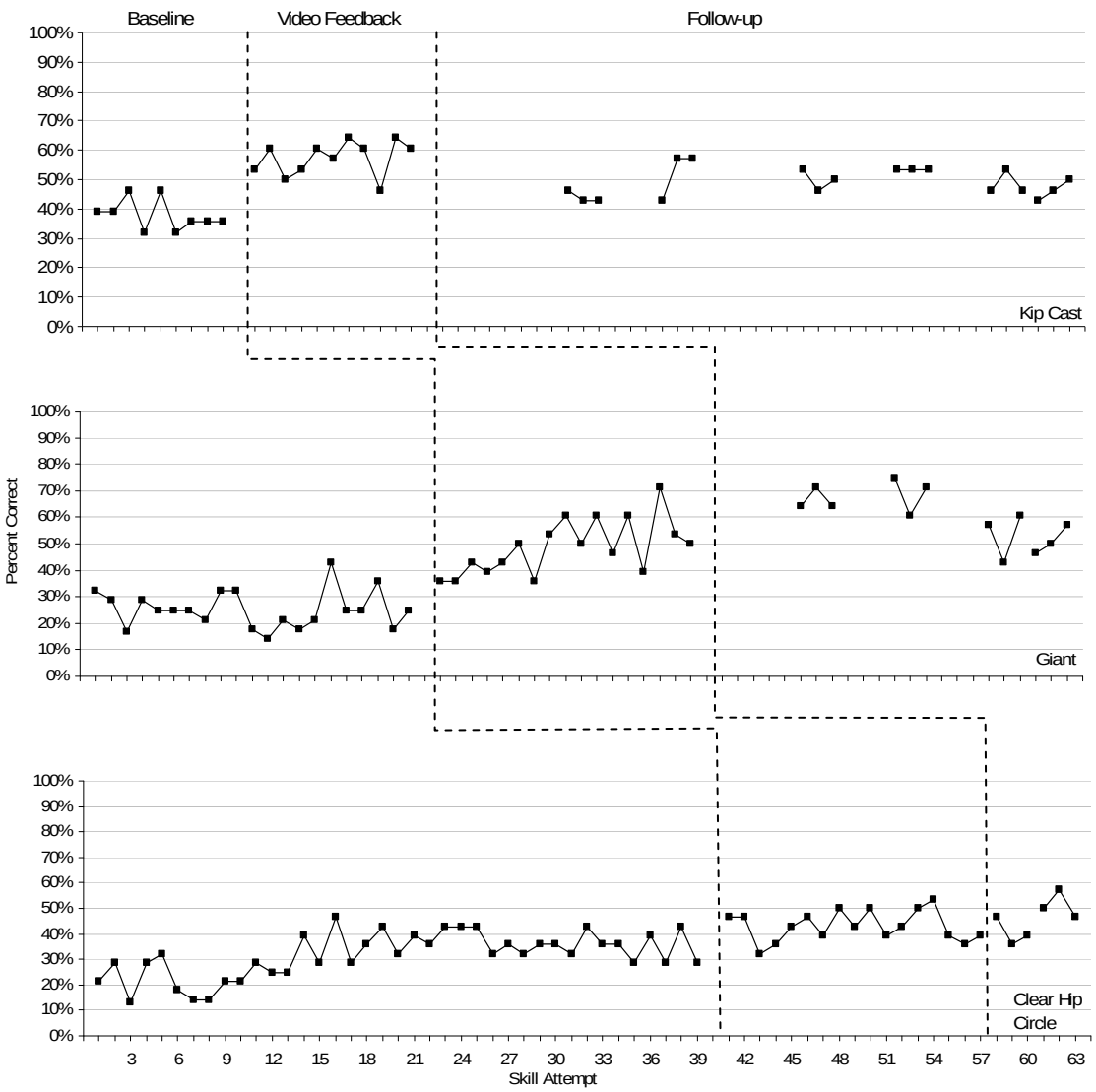

Figure 2. Multiple baseline across behaviors for Colleen

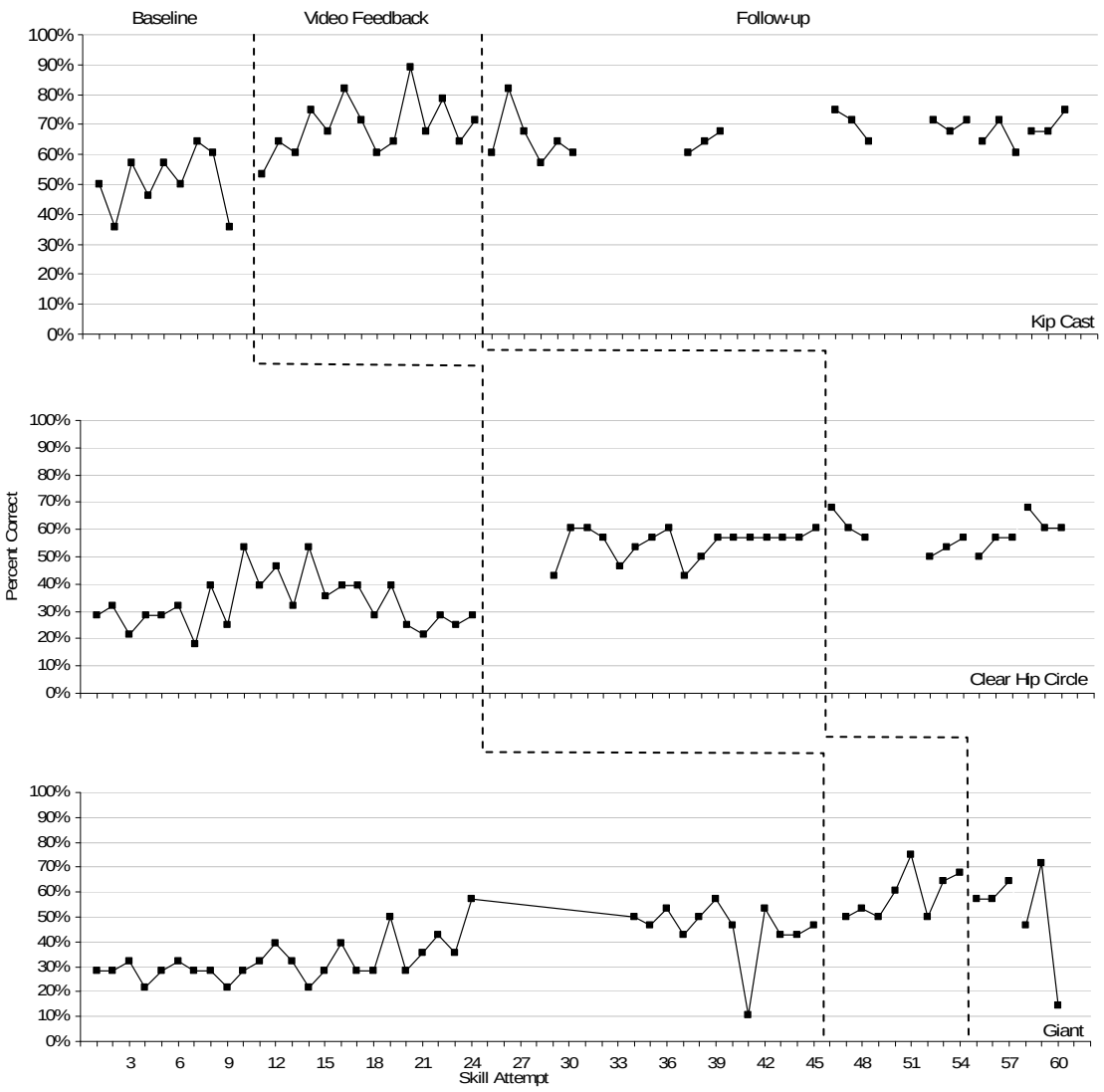

Figure 3. Multiple baseline across behaviors for Serena

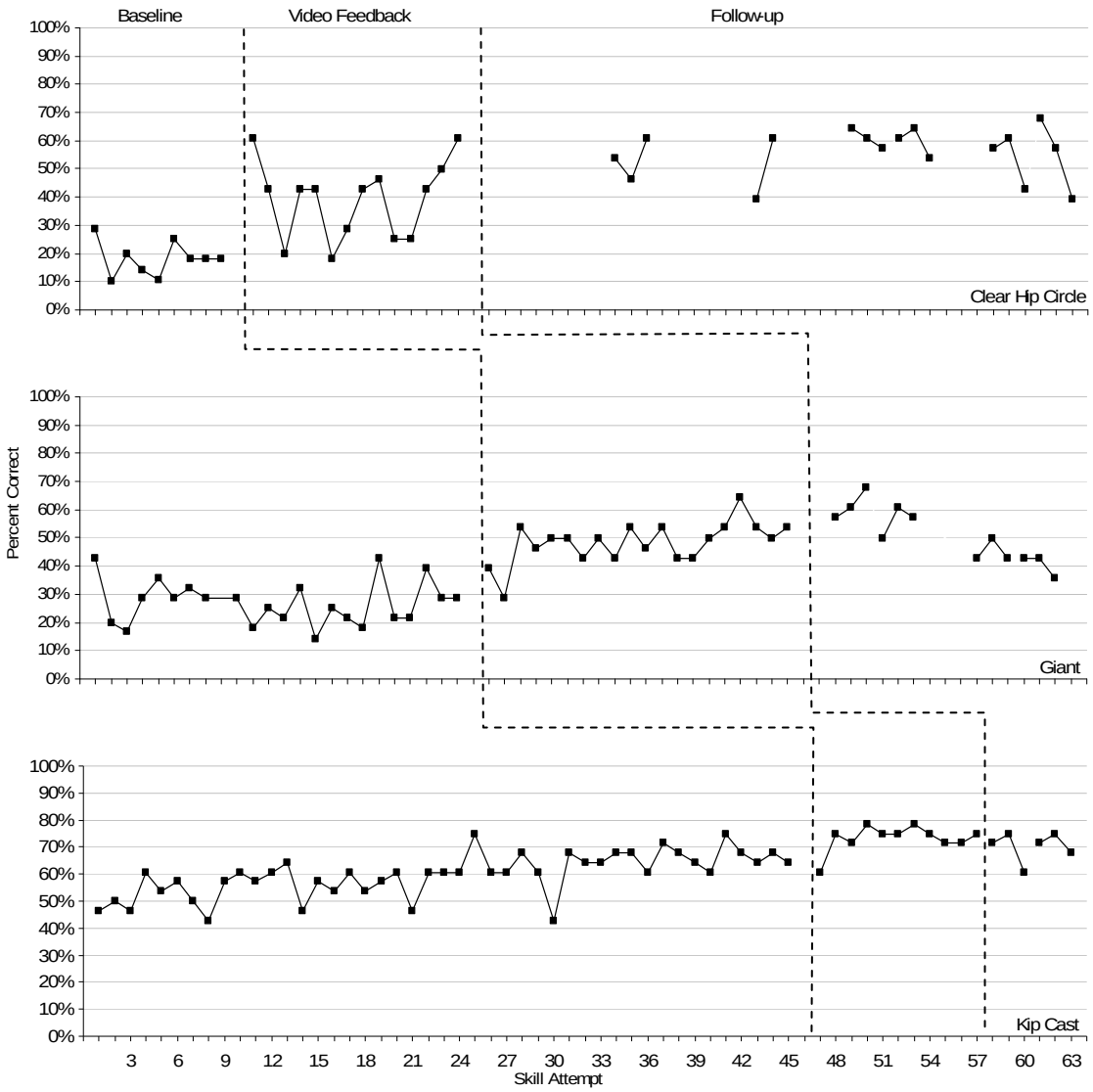

Figure 4. Multiple baseline across behaviors for Megan

Chapter Four

Discussion

The purpose of this study was to examine the effects of combining expert video modeling with video feedback on the development of three gymnastics skills. The results indicate that exposure to the video feedback intervention improved skill performance more quickly than regular practice and coaching alone. During the baseline phase, some skills were practiced for as long as 5-6 weeks (15-18 gymnastics practices), under regular coaching conditions and the skills remained relatively stable, with moderate upward trends in some cases, across this period of time. Each of the three skills for each gymnast increased to above baseline levels, usually within one week of receiving the intervention procedure for that skill. Gymnasts showed improvement, in many cases double their baseline levels, following their first video feedback session. These results suggest that adding expert video modeling with video feedback to typical coaching and practice techniques could reduce the number of practice sessions required to master a difficult physical skill. Following the intervention, in many cases, the percentage of the skill performed correctly approximately doubled in comparison to both their overall and end of baseline scores.

A multiple baseline design across behaviors was used to experimentally demonstrate the effects of the intervention. By systematically exposing different skills of the participants to the intervention at different points in time, it was possible to show that the observed changes in behavior (skill improvement) occurred primarily after receiving

the intervention for a specific 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.

Although some of the gymnasts' skills showed increases in the percentage correct during follow-up, some skills decreased during the last two weekly follow-up sessions. It is possible that coaching techniques or practices were modified during these one week break periods. The gymnasts may have practiced these skills more frequently when the video taping occurred three times a week compared to video taping that occurred once a week. The presence of a research team member or their equipment may have exerted some level of stimulus control over these gymnasts' behavior. The gymnasts may have performed better in the presence of research team members and their equipment because their performance had been reinforced, (opportunity to be watched and video taped) in the presence of those stimuli.

Although the video feedback intervention enhanced skill performance to above the baseline levels, near flawless skill performance (80-100% correct) was seldom achieved by the gymnasts in this study. The data also showed considerable variability, with some gymnasts dramatically improving in one skill while showing only modest improvement in another skill. This variability may be related to the difficulty of specific skills or the gymnast's repertoire of similar movements. Perhaps it was easier for a gymnast to show substantial improvement if she had mastered similar movements and or skills in the past. It is also possible that the numerous individual differences, both physical and psychological (e.g., level of motivation to perform her best during each assessment), between the gymnasts could account for the observed variability. Typically

these three skills required some level of physical assistance from the coach to be fully completed during the learning phase. It could be argued that some of the gymnasts were physically unable to perform the skills alone and form breaks, due to strength limitations, accounted for some of the variability in the skill.

The behavior checklists used in this study were created by the author (a national level gymnast) and modified after consultations with a number of national and international judges and coaches. The skill checklists were designed so that a score of 100% would be equivalent to a perfect score for a competitive gymnast performing that skill. The three skills examined in this study are generally considered to be intermediate yet difficult. Relatively few gymnasts can perform these skills to the level of the competitive gymnastics judging criteria without sight execution error. Numerous video clips of elite gymnasts' were reviewed by a USA Brevet gymnastics judge before suitable video clips were found that could be used to approximate the ideal body positions required by the criteria in this study. All video clips were performed by gymnasts on the USA national team.

The behavior checklist for this study addressed the skill elements in five freeze frames. The checklist reflected correct body positions such as arms straight, legs together, legs straight, toes pointed were repetitively scored during five different phases of each skill making up a minimum weighting of 20/28 or 71% of a skill's percentage. Therefore, the competitive behavior measurement standards may have demonstrated higher increases in skill performance if these gymnasts were capable of performing key skill components prior to the initiation of the study.

In this study scoring occurred over extended period of time (ten weeks). It was therefore suspected that observer drift might influence the results. One clear benefit of video recording the target behavior is that it is possible to rescore earlier sessions to assess the presence of observer drift. As a quality control measure we rescored earlier video clips to ensure our scoring standards remained the same over the course of the study. From this procedure, it was discovered that Serena's baseline kip cast scores changed. Following the re-scoring procedure, Serena's kip cast baseline demonstrated an upward trend before intervention, rather than the baseline stability that the previous measures had shown. One clear advantage of video recording is that it in essence creates a permanent objective and accurate record of the behavior. A video clip display of behavior can be reevaluated, where as observing and scoring behavior as it occurs does not allow a researcher to reevaluate the behavior.

Relation to Literature

This study was an attempt to extend earlier research in the area of athletic skill development. Previous studies concluded that expert video modeling and video feedback could improve athletic skills execution (Harle & Vickers, 2001; Hazen et al., 1990). In 1990, Hazen et al. implemented an intervention package that included modeling, role-playing, symbolic modeling (expert video modeling), instructions, self video feedback, and verbal feedback. Different from the current study, the expert video modeling was implemented outside the training environment and verbal feedback was provided during both the expert video and self video feedback sessions. The current study was an attempt to address a limitation in Hazen et al. (1990) study by analyzing the effect of one training component, viewing the video clip without verbal feedback, on athletic performance. In

this way the self- monitoring behavior component of video feedback could be examined more rigorously.

Several studies have examined the effects of viewing video clips of an athlete's own performance (video feedback; e. g.,Winfrey & Weeks, 1993; Zetou et al., 2002; Ziegler, 1994), while other studies have examined the effects of viewing video clips of an expert model's performance (expert video modeling; e.g., Boschker & Bakker, 2002; SooHoo et al., 2004, Zetou et al., 2002). A few studies have attempted to combine these two strategies. Basketball players compared their eye gaze during their own free throw shooting to the eye gaze of experts and free throw performance increased (Harle & Vickers, 2001). Unlike the current study, these basketball players reviewed their quiet eye (player's final gaze on hoop area) data in comparison to a video of an expert's eye gaze and were taught a three step routine (stance, hold, shoot) during a feedback session and later on the basketball court. The principle similarity of the current study to Harle and Vickers (2001) research was the simultaneous presentation of video feedback and expert video modeling to the athlete. The present study expanded the use of expert video modeling with video feedback from a simple eye gaze behavior to several complex athletic skills involved in gymnastics routines. The gymnasts learned difficult skills during fewer practice sessions when exposed to the video feedback intervention than when they were receiving only their normal training conditions.

Limitations and Future Research Considerations

Due to the technical limitations of the video cameras that were used, the freeze frame images of the gymnasts were sometimes slightly blurred. This problem was most evident when viewing the fast moving extremities of feet and leg positions. Future

researchers should use better quality (more frames per second) video cameras in order to capture clearer body images. The clearer video images would provide more opportunity for the gymnast to discriminate various elements of their body positions as correct or incorrect.

Another limitation is that the expert gymnast clips and the novice gymnast clips could not run in perfect synchronization because each gymnast performed the skill in a different amount of time. This problem of obtaining clear and fully synchronized video clips which matched the expert gymnast with the novice gymnast in the freeze frames was a technological hurdle. This created some delays in presenting the video feedback to the gymnast. 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.

Additional limitations included gymnastics injuries arising during routine gymnastics practice. Minor injuries often occur in athletic performance and in this study some of the gymnasts developed injuries doing other skills, which to some degree impaired their performance of the skills being measured in this study. For example, one athlete was unable to fully straighten her leg due to a heel injury and this affected her scores. The presence of injuries to the gymnasts was a variable beyond the control of the experimenter.

As previously mentioned, these gymnasts were learning these skills as video feedback was implemented. The video feedback procedure may have been more effective in improving skill performance for athletes who had already acquired the basic components of the skill. Future research needs to replicate this study with basic skills the

gymnast has nearly mastered or performed in competition. In this way the athletes could focus more on fine motor movements, without the additional task of learning the gross body movements of the skill. Unfortunately, the athletes in this study were required to do both simultaneously. The author argues that video feedback for competitive gymnasts has the potential to be most effective for increasing the execution of a skill after the skill has already been learned at a basic performance level.

Conclusion

The present study examined the effects of combining expert video modeling and video feedback on the development of three complex athletic skills used in gymnastics routines. This study demonstrated that the young gymnasts improved their skill performance scores for each skill when the video feedback intervention was added to their normal practice sessions. The study also demonstrated that gymnasts learned the skills in fewer practice sessions when exposed to video feedback, in comparison to their normal training conditions. Expert video modeling with video feedback was an acceptable intervention, in which participants improved their skill performance and these improvements were largely maintained during follow-up assessments.

References

Allison, M. G., & Ayllon, T. (1980). Behavioral coaching in the development of skills in football, gymnastics, and tennis. *Journal of Applied Behavior Analysis, 13,* 297 314.

Anderson, G., & Kirkpatrick, M. A. (2002). Variable effects of a behavioral treatment package on the performance of inline roller speed skaters. *Journal of Applied Behavior Analysis, 35,* 195-198.

Boschker, M. C. J., & Bakker, F. C. (2002). Inexperience sport climbers might perceive and utilize new opportunities for action by merely observing a model. *Perceptual and Motor Skills, 95,* 3-9.

Buzas, H., & Ayllon, T. (1981). Differential reinforcement in coaching tennis skills. *Behavior Modification, 5,* 372-385.

Dowrick, P. W., & Dove, C. (1980). The use of self-modeling to improve the swimming performance of spina bifida children. *Journal of Applied Behavior Analysis, 13,* 51-56.

Fitterling, J. M., & Ayllon, T. (1983). Behavioral coaching in classical ballet: Enhancing skill development. *Behavior Modification, 7,* 345-368.

Harle, S. K., & Vickers, J. N. (2001). Training quick eye improves accuracy in the basketball free throw. *The Sport Psychologist, 15,* 289-305.

Hazen, A., & Johnstone, C., & Martin, G. L., & Srikameswaran, S. (1990). A videotaping feedback package for improving skills of youth competitive swimmers. *The Sport Psychologist, 4,* 213-227.

Kladopoulos, C. N., & McComas, J. J. (2001). The effects of form training on foul-shooting performance in members of a women's college basketball team. *Journal of Applied Behavior Analysis, 34,* 329-332.

Komaki, J., & Barnett, F. T. (1977). A behavioral approach to coaching football: Improving the play execution of the offensive back-field on a youth football team. *Journal of Applied Behavior Analysis, 10,* 657-664.

McKenzie, T. L., & Rushall, B. (1974). Effects of self-recording on attendance and performance in a competitive swimming training environment. *Journal of Applied Behavior Analysis, 7,* 199-206.

Scott, D., Scott, L. M., & Goldwater, B. (1997). A performance improvement program for an international-level track and field athlete. *Journal of Applied Behavior Analysis, 30,* 573-575.

Scott, D., Scott, L. M., & Howe, B. L. (1998). Training anticipation for intermediate tennis players. *Behavior Modification, 22,* 243-261.

Smith, S. L., & Ward, P. (2006). Behavioral interventions to improve performance in collegiate football. *Journal of Applied Behavior Analysis, 39,* 385-391.

SooHoo, S., Takemoto, K. Y., & McCullagh, P. (2004). A comparison of modeling and imagery on the performance of a motor skill. *Journal of Sport Behavior, 27,* 349-366.

Winfrey, M. L., & Weeks, D. S. (1993). Effects of self-modeling on self-efficacy and balance beam performance. *Perceptual and Motor Skills, 77,* 907-913.

Wolko, K. L., Hrycaiko, D. W., & Martin, G. L. (1993). A comparison of two self-management packages to standard coaching for improving practice performance of gymnasts. *Behavior Modification, 17,* 209-223.

Zetou, E., Tzetzis, G., Vernadakis, N., & Kioumourtzoglou, E. (2002). Modeling in learning two volleyball skills. *Perceptual and Motor Skills, 94,* 1131-1142.

Ziegler, S. G. (1994). The effects of attentional shift training on the execution of soccer skills: A preliminary investigation. *Journal of Applied Behavior Analysis, 27,* 545-552.

Appendices

Appendix A: Skill Component Checklist

Kip Cast Criteria Participant___

Behavior Analyst:_____ Date:_____

		Skill Attempts in a Practice					
		1		2		3	
Components Completed		Yes	No	Yes	No	Yes	No
Phase 1	1. Glide with straight body position extended hands through feet						
	2. Correct head alignment (head between arms)						
	3. Arms straight (elbows not bent)						
	4. Legs together at end of glide						
	5. Legs straight (knees not bent)						
	6. Feet pointed						
Phase 2	1. Chest in hollow body position (no arch)						
	2. Arms straight (elbows not bent)						
	3. Legs together						
	4. Legs straight (knees not bent)						
	5. Feet pointed						
Phase 3	1. Gymnast maintains extended body position (no arch; slight pike allowed) as she moves around bar						
	2. Arms straight (elbows not bent)						
	3. Legs together						
	4. Legs straight (knees not bent)						
	5. Feet pointed						
Phase 4	1. Casts with straight body position (no arch; no pike)						
	2. Casts with hips clear of bar						
	3. Arms straight (elbows not bent)						
	4. Legs together						
	5. Legs straight (knees not bent)						
	6. Feet pointed						
Phase 5	1. Casts 45° from vertical (minimum)						
	2. Straight body position (no arch or pike)						
	3. Arms straight (elbows not bent)						
	4. Legs together						
	5. Legs straight (knees not bent)						
	6. Feet pointed						

Clear Hip Circle Criteria Participant___

Behavior Analyst:_____ Date:_____

		Skill Attempts in a Practice					
		1		2		3	
Components Completed		Yes	No	Yes	No	Yes	No
Phase 1	1. From cast, executes downward swing with extended body position (no arch or pike)						
	2. Hips clear of bar						
	3. Arms straight (elbows not bent)						
	4. Legs together						
	5. Legs straight (knees not bent)						
	6. Feet pointed						
Phase 2	1. Gymnast maintains extended body position (no arch; slight pike allowed)						
	2. Arms straight (elbows not bent)						
	3. Legs together						
	4. Legs straight (knees not bent)						
	5. Feet pointed						
Phase 3	1. Gymnast maintains extended body position (no arch; slight pike allowed) ¾ circle around bar						
	2. Hips clear of bar						
	3. Arms straight (elbows not bent)						
	4. Legs together						
	5. Legs straight (knees not bent)						
	6. Feet pointed						
Phase 4	1. Gymnast maintains extended body position (no arch or pike) just past the ¾ circle around bar						
	2. Arms straight (elbows not bent)						
	3. Legs together						
	4. Legs straight (knees not bent)						
	5. Feet pointed						
Phase 5	1. Circle completed 45° from vertical (minimum)						
	2. Achieves extended body position (no arch or pike)						
	3. Arms straight (elbows not bent)						
	4. Legs together						
	5. Legs straight (knees not bent)						
	6. Feet pointed						

Back Giant Circle to Handstand Criteria Participant___

Behavior Analyst:_____ Date:_____

		Skill Attempts in a Practice					
		1		2		3	
Components Completed		Yes	No	Yes	No	Yes	No
Phase 1	1. Initiate extended body position (no arch or pike) within 45° from vertical (minimum)						
	2. Arms straight (elbows not bent)						
	3. Legs together						
	4. Legs straight (knees not bent)						
	5. Feet pointed						
Phase 2	1. Descent phase performed with extended body position (no arch)						
	2. Correct head alignment (head between arms)						
	3. Arms straight (elbows not bent)						
	4. Legs together						
	5. Legs straight (knees not bent)						
	6. Feet pointed						
Phase 3	1. Just before reaching the bottom of high bar, body changes to tight arch with feet behind bar						
	2. Correct head alignment (head between arms)						
	3. Legs together						
	4. Legs straight (knees not bent)						
	5. Feet pointed						
Phase 4	1. Following tap swing, gymnast snaps to a hollow body position (no arch)						
	2. Arms straight (elbows not bent)						
	3. Legs together						
	4. Legs straight (knees not bent)						
	5. Feet pointed						
Phase 5	1. Gymnast attains handstand within 10° from vertical						
	2. Extended body position (no arch or pike)						
	3. Correct head alignment (head between arms)						
	4. Arms straight (elbows not bent)						
	5. Legs together						
	6. Legs straight (knees not bent)						
	7. Feet pointed						

Appendix B: Gymnastics Skills Definitions

Skills performed by the expert gymnast

Giant (backwards giant)

A “Giant” is an advanced gymnastics maneuver in which an athlete firmly grips a high bar with both hands and completes a 360 degree (rotation) around the bar. The gymnast begins this skill in a vertical handstand position on top of the bar. The gymnast then swings rapidly downward toward the low (toes lead the swing). The momentum generated by this downward swing carries the gymnast back to the starting position i.e., to a vertical handstand on top of the bar.

Kip Handstand (low bar)
A kip to hand stand is an advanced gymnastics maneuver which combines 2 skills, the kip and the handstand. The gymnast must use the momentum from the kip to swing to a handstand position on the bar.
The gymnast stands on a mat in front of the bar to begin this skill. She jumps forward and catches the low bar with both hands, then swings forward beneath the bar with her body in an L shape position leading with her toes. When her body has passed beneath the bar and is fully extended, she then bends at the hips and brings her toes to the bar. Next the gymnast quickly swings her legs down from the bar and this motion causes the gymnast to swing back under the bar and upward to a front support position (arms and body straight with hips resting on the bar.)
When a gymnast performs a kip to handstand, the momentum of the kip continues, and the gymnast pushes herself into the handstand position on the bar.

Clear Hip Circle to Handstand
A clear hip circle is a 360 degree rotation of the gymnast’s body around the bar with the gymnast’s hips held a few inches away from the bar as it circles around the bar. As the skill nears completion, the gymnast’s body is moving upward, and the gymnast pushes downward on the bar, and thrusts her body upward, and finishes the skill in a handstand on the bar.

Appendix C: Social Validity

Gymnast Questionnaire

Please carefully read and answer this 8 item questionnaire independently. Complete each item by making a **checkmark** on the line above the response that best indicates your reaction to that statement. Please note that each item also includes space for your comments if you wish to clarify or explain your choice.

1. The video feedback was helpful.

_____	_____	_____	___1___	___3___
strongly disagree	disagree	don't know	agree	strongly agree

Comments:

2. I think my gymnastics skill got better from watching the video.

_____	_____	_____	___3___	___1___
strongly disagree	disagree	don't know	agree	strongly agree

Comments:

3. Video feedback was easy to follow.

_____	_____	___1___	_____	___3___
strongly disagree	disagree	don't know	agree	strongly agree

Comments:

4. I was able to compare myself to the expert gymnast.

_____	_____	_____	___3___	___1___
strongly disagree	disagree	don't know	agree	strongly agree

Comments:

5. Video feedback helped me change my skill to look more like the expert gymnast.

strongly disagree	disagree	don't know	agree	strongly agree
_____	_____	___1___	___2___	___1___

Comments:

6. The video feedback trainer did a good job in showing me my video feedback.

strongly disagree	disagree	don't know	agree	strongly agree
_____	_____	_____	___1___	___3___

Comments:

7. Overall, I liked video feedback.

strongly disagree	disagree	don't know	agree	strongly agree
_____	_____	_____	__1___	___3___

Comments:

8. I would tell other gymnasts to use video feedback.

strongly disagree	disagree	don't know	agree	strongly agree
_____	_____	___1___	___1___	___2___

Comments:

Coach Questionnaire

Please carefully read and answer this 8 item questionnaire independently. Complete each item by making a **checkmark** on the line above the response that best indicates your reaction to that statement. Please note that each item also includes space for your comments if you wish to clarify or explain your choice.

C=Coach (1); A=Assistant Coach (2)

1. I believe video feedback was helpful to the gymnasts.

_____	_____	_____	___A___	__C, A__
strongly disagree	disagree	neutral	agree	strongly agree

Comments: A "Visual 'Teachable Moment' was not used with coach and athlete"

2. I believe the gymnasts skills have improved with the addition of the video feedback.

_____	_____	_____	_A, A__	___C___
strongly disagree	disagree	neutral	agree	strongly agree

Comments: A "Some gymnasts have intrinsic visual learning ability along with the maturity to process information independently."

3. The video feedback procedure was easy to add to the gymnastics practice.

_____	_____	__A___	___C___	__A____
strongly disagree	disagree	neutral	agree	strongly agree

Comments: C "Large Screen TV"

4. The gymnasts were able to compare their skill to the expert gymnast.

_____	_____	_____	___A__	_C, A___
strongly disagree	disagree	neutral	agree	strongly agree

Comments:

5. Video feedback helped the gymnasts change their skill to look more like the expert gymnast.

strongly disagree	disagree	neutral	agree	strongly agree
_____	_____	_____	__A___	__C, A___

Comments:

6. The video feedback trainer did a good job in presenting the video feedback to the gymnasts.

strongly disagree	disagree	neutral	agree	strongly agree
_____	_____	_____	_____	__C, A, A__

Comments:

7. Overall, I had a positive reaction to this video feedback program.

strongly disagree	disagree	neutral	agree	strongly agree
_____	_____	_____	__A , A__	___C___

Comments:

8. I would recommend video feedback to other coaches/gymnasts.

strongly disagree	disagree	neutral	agree	strongly agree
_____	_____	_____	__A___	__C, A___

Comments: A “Video feedback can be a very useful tool as long as it is presented correctly”

A “Video feedback is one of the best coaching tools”

Appendix D: Gymnastics Judging Scores

Procedures

A panel of three gymnastics officials evaluated the gymnastics elements performed by gymnasts on 44 video clips. The officials held USA Brevet ratings, the highest rating for officials within the USA Junior Olympic program. All three officials had 25 or more years experience judging at local, state, and national levels.

Each video clip contained one element performed by one gymnast. The video clips were numbered 1 – 44 and included the following elements:

16 glide kip, cast to handstand with a minimum of 21 - 45 degrees from vertical
16 clear hip circle minimum of 21 - 45 degrees from vertical
12 giant circles to within 10 degrees of vertical or better

The video clips were viewed by the judging panel using a computer screen with each clip being played in sequential order from 1 to 44. Elements were randomly sequenced in the presentation. Each judge independently rated each skill using two scales. First, the judges rated the skill to determine if the athlete reached the minimum angle required for the element. The judge rated the skill as "Yes" if the athlete achieved the minimum angle for the skill and "No" if the athlete did not achieve the required angle. Second, the judges applied the deductions the gymnast would receive if she attempted the skill in a competition. The deductions listed in the *USAG Junior Olympic Code of Points: 2005-2009* were applied to the skills for each execution error observed. Deductions were taken in tenths or half-tenths and summed to obtain a total for the entire skill. A higher number represented a larger number of execution errors. For example, a gymnast who performed an element with her arms bent 90º would receive a deduction of -.3; if her legs were also bent 90º she would receive another -.3 deduction for a total of -.6 in deductions. If another gymnast performed these same errors but to a lesser degree, the individual deductions, as well as the total deductions, would be less for the skill.

The criteria established for awarding credit to the element performed were that: (1) the gymnast must complete the skill within the minimum degree requirement and (2) the gymnast must perform the element with .3 or less in execution errors. If both of these conditions were met, the element was awarded.

The resulting score was recorded as a Y or N to reflect the angle achieved by the gymnast followed by a number to reflect the number of execution errors recorded by the judging panel. For example, a Y3 meant that the skill performed met the minimum required height angle and was performed with .30 in execution deductions.

About the Author

Eva Sara Boyer received her Bachelor's Degree (psychology) in 2005 from University of Victoria, in British Columbia, Canada. Ms. Boyer, a former competitive gymnast and gymnastics coach, has always been interested in improving teaching and training techniques.

Ms. Boyer applied to the Applied Behavior Analysis Master's degree program at the University of South Florida (USF) after hearing Dr. Miltenberger speak at the Applied Behavior Analysis (ABA) convention in 2006. In August 2006, Ms. Boyer moved to Florida to attend graduate school. Many people involved in the ABA Master's program at USF assisted Ms. Boyer with her transition from Canada to the United States and into the graduate program. After completing her Master's degree in Applied Behavior Analysis, Ms. Boyer plans to become a Board Certified Behavior Analyst (BCBA), work with children and continue investigating behavior change in athletic settings.