



# Using Video Self-Evaluation to Enhance Performance in Competitive Dancers

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## Abstract

This study used a multiple-baseline across-behaviors design to evaluate the use of video self-evaluation on the performance of 3 dance movements. The procedure improved all 3 dance moves for 3 adolescents on a competitive dance team. Video self-evaluation was shown to be an efficient, accessible, and socially valid procedure to increase the performance of competitive dance movements.

**Keywords** Dance · Video self-evaluation · Sports

Research on behavioral procedures in sports began in the 1970s (Komaki & Barnett, 1977; McKenzie & Rushall, 1974). In the general methodology of behavioral coaching, as shown in Komaki and Barnett (1977) and Allison and Ayllon (1980), coaches assess sports skills to improve, apply a behavioral procedure as an intervention, and evaluate progress in the athlete's performance of the skill. In Komaki and Barnett (1977), the coaches used a checklist format (task analysis) and feedback to teach the players how to complete offensive plays. After each play, the coach reviewed what steps were done incorrectly and what steps were done correctly. This process was replicated across three plays, which yielded positive results. Since then, behavioral coaching has expanded to include a variety of behavioral procedures. A recent review by Schenk and Miltenberger (2019) showed the breadth of research on behavioral interventions in sports. They found more than 100 articles evaluating behavioral procedures to enhance performance across 21 different sports. A variety of antecedent and consequent interventions has been successful for enhancing sports performance, including auditory feedback (Carrion, Miltenberger, & Quinn, 2018), forward and backward chaining (Moore & Quintero, 2019), behavioral skills training (BST; Tai & Miltenberger, 2017), and public posting (McKenzie & Rushall, 1974), to name a few. For

example, Scott, Scott, and Goldwater (1997) showed a prompting and shaping procedure with auditory feedback successfully increased a pole-vaulter's arm extension and jump height. As another example, Boyer, Miltenberger, Batsche, and Fogel (2009) used video modeling and video feedback to enhance the performance of gymnastics skills in four participants. Video modeling and feedback improved skill performance in all participants, and this improvement was maintained during follow-up observations.

Dance was one of the sports included in the review by Schenk and Miltenberger (2019). Although they found only four studies focusing on dance performance, this research shows behavioral interventions can be applied successfully to improve dance performance. These studies broke down dance movements into small, measurable steps that must occur in sequence to be scored as a correct performance of the movement. Each of these studies measured the percentage of steps performed correctly in the task analysis as a measure of improvement following training. In an early study, Fitterling and Allyon (1983) evaluated behavioral coaching that included all the components of BST (instructions, modeling, rehearsal, and feedback) to teach ballet skills to young dancers. They found the behavioral coaching procedures were more effective than standard instruction. Quinn, Miltenberger, and Fogel (2015) found that utilizing a behavioral intervention known as TAGteach increased dance performance for three out of four students. TAGteach uses auditory feedback delivered through a clicker to reinforce the correct performance of steps in a task analysis. The researchers added an additional phase for the fourth student in which she earned tokens with

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an auditory feedback procedure, which led to more positive results. Another article evaluated auditory feedback implemented by peers (Quinn, Miltenberger, Abreu, & James, 2017a). Results showed that all students receiving auditory feedback improved in their skill performance, and some students who delivered auditory feedback to their peers also saw some improvements in their skills even though they did not receive the feedback for their performance. Quinn, Miltenberger, Abreu, and Narozanick (2017b) evaluated the effects of public posting on dancers' performance. The students had the opportunity to earn a publicly posted gold star if their performance scores improved from the previous session. Results showed that posting the dancers' scores each week for their classmates to view was effective in increasing their performance scores in future weeks.

Most recently, Quinn, Narozanick, Miltenberger, Greenberg, and Schenk (2019) evaluated video modeling and video feedback to enhance dance performance. They first used video modeling and then added video feedback if needed to enhance the performance of dance skills. When video modeling was applied alone, the dancers' improvements were slight. After the researchers added a video feedback component, the dancers' scores improved even more. Thus, it appears that video feedback was a more effective procedure than video modeling for enhancing dance performance. Other researchers have shown video feedback is an effective intervention for enhancing performance in other sports such as martial arts (Benitez-santiago & Miltenberger, 2015), horseback riding (Kelley & Miltenberger, 2016), and golf (Guadagnoli, Holcomb, & Davis, 2002).

In an attempt to increase the efficiency of video feedback, Downs, Miltenberger, Biedronski, and Witherspoon (2015) studied the effects of video self-evaluation on enhancing the execution of yoga postures. In the video self-evaluation procedure, the athlete executes the skill while being video recorded and then views the video while evaluating his or her own performance. In this way, the presence of a coach or trainer is not required to provide video feedback, and thus the procedure can be more efficient or accessible. Because video self-evaluation is a promising procedure for use in sports and only one study to date has evaluated video self-evaluation to enhance athletic performance, the purpose of this study was to evaluate the procedure for enhancing dance performance.

## Method

### Participants and Setting

Participants were two male and one female competitive dance students recruited through flyers handed out by their dance instructors. Each participant met inclusion criteria of being at least 10 years old, having at least 3 years of dance competition

experience, being currently enrolled in a competitive-level dance team, and currently lacking proficiency in at least three dance movements. Amelia was 16 years old and had been dancing for 11 years, Eli was 11 years old and had been dancing for 6 years, and Kyle was 13 years old and had been dancing for 10 years. The study took place at the participants' dance studio in Tampa, Florida. The studios used for sessions all had a marley (a thin, vinyl material) floor that had dimensions sufficient for execution of each dance movement.

### Materials

The materials used in this study included a task analysis for each specific dance movement, a video recording device with a playback feature (i.e., a standard iOS recording system on an iPad), and a scoring sheet for the dance instructor and participant to collect data on the students' performance. All participants reported that they had experience using the iOS recording system used in this study. A treatment integrity checklist was used by the researcher to score the participants' use of self-evaluation during 33% of sessions.

### Target Behavior and Data Collection

The dependent variable was the percentage of correct steps completed on a task analysis created for each dance movement (see supplemental materials). The participants' primary dance instructor chose the dance movements on which each student was currently struggling, including a single or double pirouette, a fan kick, and *chassé grand jeté*. Each movement was topographically distinctive from the other movements, so improvements in the performance of one movement were unlikely to affect the performance of another. The task analyses were created by breaking down each skill into a chain of sequential, observable, individual steps that make up the entire dance movement. Each task analysis ranged from 18 to 23 steps. The researcher created the task analyses with the dance teacher in order to enhance the social validity of each task analysis. The supplemental materials display the task analyses used during the study.

Data were collected via video recordings in each session by the researcher and an independent observer who scored the target behaviors using the task analyses for each movement. The percentage of correct steps completed was calculated by dividing the number of correct steps completed by the number of steps in the task analyses multiplied by 100.

### Interobserver Agreement

Interobserver agreement (IOA) was calculated for at least 33% of the sessions in this study. The researcher and one research assistant scored the selected video for IOA purposes. The research assistant was blind to the condition in which he or

she scored the target behavior. The researcher trained the research assistant on data collection via BST. The researcher assessed the research assistant's proficiency in scoring the target behaviors by using model videos of expert and nonexpert performances of the target behaviors. The research assistant demonstrated at least 90% IOA with the researcher before scoring the data collected in the study. An agreement between both observers occurred when both observers scored the target step as occurring or not occurring. IOA was calculated by dividing the number of agreements by the number of steps in the specific task analysis and multiplying by 100.

The average IOA for all participants was 92%. For Amelia, mean IOA collected for 33% of sessions was 94% (range 83%–100%) for the fan kick, 92% (range 83%–100%) for the grand jeté, and 92% (range 85%–100%) for the pirouette. For Eli, mean IOA collected for 33% of sessions was 91% (range 73%–100%) for the pirouette, 92% (range 72%–100%) for the fan kick, and 91% (range 78%–100%) for the grand jeté. For Kyle, mean IOA collected for 36% of sessions was 95% (range 87%–100%) for the grand jeté, 94% (range 75%–100%) for the pirouette, and 92% (range 72%–100%) for the fan kick.

### Social Validity

Social validity questionnaires were used to assess the dancers' reactions to the intervention, including how much they liked the intervention and how effective they perceived the intervention to be (see supplemental materials). The questionnaire included a 6-point Likert scale and five open-ended questions. Social validity was also assessed on the progress each student made with each target behavior. Two videos from baseline and two videos from the intervention phase were shown to the students' dance instructor, as well as an additional dance instructor. The instructors rated the performance on a scale of 1–10, 1 being poor performance and 10 being expert performance. The baseline and intervention videos were presented in random order.

### Treatment Integrity

Treatment integrity of a student's use of video self-evaluation was assessed using two methods. The researcher scored the student's treatment integrity on the self-evaluation procedure using a treatment integrity checklist that included details such as whether the student watched the video, scored using the task analysis checklist, and whether the student filled out a response for each step in the task analysis. Treatment integrity on scoring fidelity was also measured by collecting IOA on the performance scores that the student obtained. If IOA between the student and the researcher fell below 80%, the researcher retrained the student on how to score the target behaviors using the task analysis. Treatment integrity was also

assessed on the researcher's use of BST to conduct self-evaluation training.

Treatment integrity was assessed in 100% of sessions for each participant. All three participants scored 100% in fidelity for implementing the self-evaluation procedure. Treatment integrity of the researcher's use of BST was assessed by the research assistant for 33% of trainings. The researcher's treatment integrity score was 97% across all observations.

### Design and Procedure

We used a multiple-baseline across-behaviors design to evaluate the effectiveness of self-evaluation on the performance of three dance movements for each participant.

**Baseline** Baseline sessions consisted of the instructor telling the student to perform each of the three target behaviors three times per session. The instructor video recorded the target behaviors and provided no feedback. The dance student did not have access to the task analysis or the video of his or her performance during baseline. Once the student attempted each of the target behaviors, the instructor thanked the student for his or her time and ended the session.

**Self-evaluation Training** The researcher utilized BST to teach the student participant how to score his or her data using the task analysis. An overview of the task analysis steps and instructions on how to score using the task analysis took place first. Next, the researcher used one of the participant's baseline videos of the target behavior to demonstrate how to score the dance skill. The researcher demonstrated how to view the video multiple times in order to focus on different aspects of the movement, and to pause, rewind, and zoom the video in order to view all parts of the movement necessary for scoring with fidelity. Then, the student had an opportunity to score a different baseline video of him- or herself completing the target behavior in order to rehearse the scoring procedure and receive feedback, as needed. Once the student obtained 90% IOA with the researcher, the training session was completed. This training took place at the beginning of each intervention phase for all three target behaviors and took 30–40 min.

**Video Self-evaluation** Each of the intervention sessions began with the student completing the dance movement while being video recorded. The student watched the video and scored the dance movement using the task analysis scoring sheet. The student then completed the movement and scored that video two more times. After evaluating three videos of his or her performance, the student participated in an assessment. The student performed the movement three times and completed the other two movements three times while being video recorded for data collection purposes. Each intervention session followed this format; the participant performed the movement

and evaluated his or her own performance from video three times and then engaged in the movement three times for data collection purposes. All data reported in the figure were collected by the researcher in the assessment trials. Each intervention video ranged from 10 to 30 s, depending on the length of the movement performed, and each session ranged 15 to 44 min, depending on how long the participant took to score his or her video.

## Results

Video self-evaluation produced an improvement in performance for all dance movements. Results for Amelia, Eli, and Kyle are shown in Figure 1, Figure 2, and Figure 3, respectively. The means for intervention are calculated using the last five data points of the intervention phases (Boyer et al., 2009).

For Amelia (Figure 1), performance of the fan kick increased from a mean of 37% in baseline to a mean of 95% in intervention. The grand jeté increased from a mean of 34% in baseline to a mean of 65% in intervention. Amelia's pirouette increased from a mean of 30% in baseline to a mean of 59% in intervention.

For Eli (Figure 2), the pirouette increased from a mean of 32% in baseline to a mean of 88% in intervention. The fan kick increased from a mean of 49% in baseline to a mean of 88% in intervention. The grand jeté increased from a mean of 50% in baseline to a mean of 76% in intervention.

For Kyle (Figure 3), the grand jeté increased from a mean of 32% in baseline to a mean of 90% in intervention. The pirouette increased from a mean of 32% in baseline to a mean of 72% in intervention. The fan kick increased from a mean of 43% in baseline to a mean of 76% in intervention.

Table 1 shows students' social validity results. Overall, all participants rated the procedure highly in regard to their beliefs that the procedure helped them improve their performance and that they thought the procedure was not too difficult to implement. Some short-answer responses were that the only thing the participant found difficult was having to review the video multiple times to complete the checklist, that they would recommend this procedure to another person, and that they liked that they could see themselves succeed with the movement through the video. Additionally, all participants stated that they enjoyed participating in the study. Table 2 shows the dance instructors' ratings of the dance movements in baseline and intervention. The results of this assessment showed higher scores during intervention videos than during baseline videos for six of the nine dance movements (increases ranged from 0.67 to 1.33 on the 10-point scale). There was no change or a negligible decrease for three dance moves (a decrease of 0.17).

## Discussion

The purpose of this study was to evaluate the effectiveness of a self-evaluation procedure for increasing performance in competitive dancers. The results indicate that the self-evaluation procedure enhanced the performance for all three target behaviors for each dancer. By conducting video self-evaluation, all dancers improved their technique while executing dance movements they typically perform in dance class, competitions, and performances. Although there were large increases in the performance of the dance movements, the ratings of the dance teachers indicated modest improvements. This finding might indicate that although the participants completed substantially more steps in the task analysis correctly, they may need to become more fluent or more nuanced in their execution to be scored more highly by dance teachers.

Similar to findings in Downs et al. (2015) with yoga moves by adults, self-evaluation was an effective intervention for increasing performance of dance skills. Furthermore, this study showed the procedure was effective with 11- to 16-year-old children. However, some of these improvements were more gradual, perhaps due to the complexity or difficulty of the technique of each move chosen. Due to this study being tailored to competitive-level dancers over the age of 10, the dance movements chosen were at a more advanced level, possibly resulting in gradual increases as opposed to immediate increases in proficiency. Also, dance movements are generally more fast-paced and dynamic than yoga postures. The rapid execution of a dance movement as advanced as the ones used during this study can make it more challenging for an individual to make improvements as rapid as those seen in Downs et al.

Given that dance movements can be modified to fit the dance genre, performance requirements, and teacher preference, the moves used during this study can have alternative versions of execution. For example, for the pirouette, the task analysis used in this study asks for the starting position to include that the feet are together and parallel. This is not something that is explicitly required to execute the movement correctly but was a feature of the movement that the primary dance instructor chose to include in the task analysis for this study. However, each dancer that participated in this study took dance classes from multiple instructors, who may require the starting position of the pirouette to look different from what was required in this study. This could also contribute to variations in responding during the study due to the participants' being asked to perform a movement differently than what is specified in the task analysis outside of their self-evaluation sessions.

Another note regarding the self-evaluation session is the range of durations required to complete the session for each participant. Sessions ranged from 15 to 44 min.

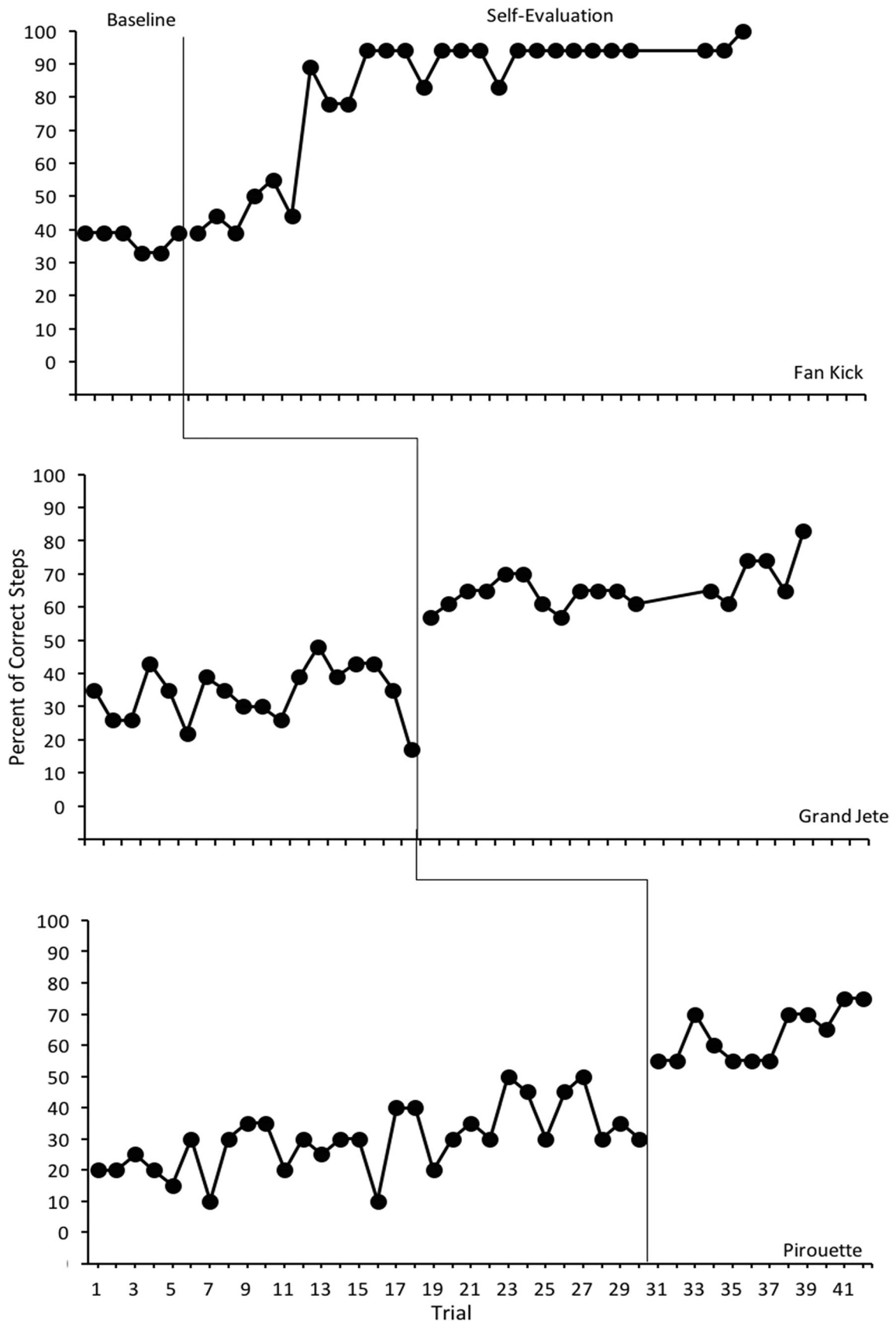


Fig. 1 Self-evaluation data for Amelia for fan kick, grand jeté, and pirouette

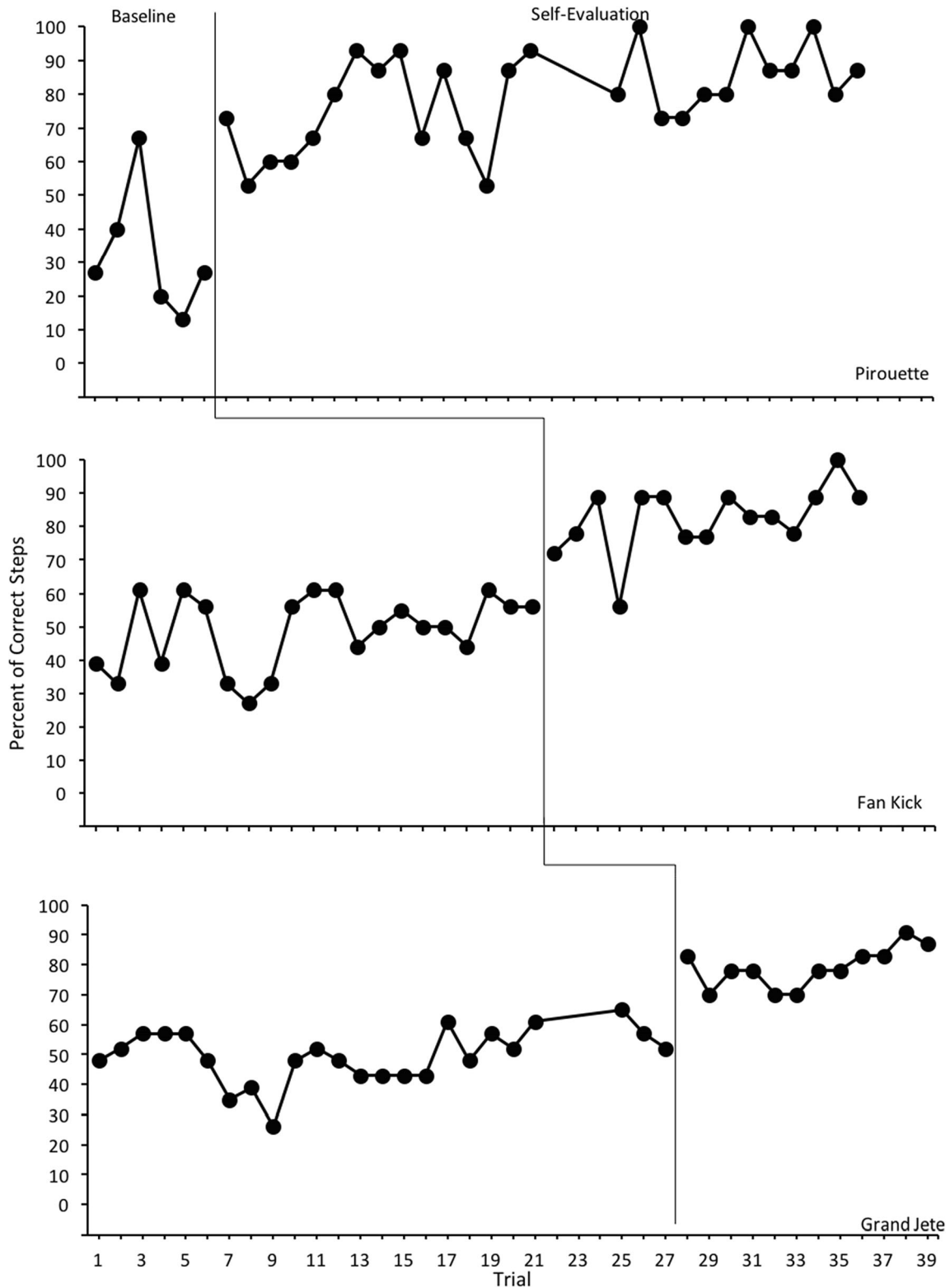


Fig. 2 Self-evaluation data for Eli for pirouette, fan kick, and grand jeté

One participant, Kyle, consistently took longer to complete the self-evaluation procedure than the other two participants. This implies that some dancers may require more time outside of class to complete the procedure. If

dance studios were to teach their dancers to use this procedure, they should expect some students to potentially take longer than others to complete the self-evaluation procedure.

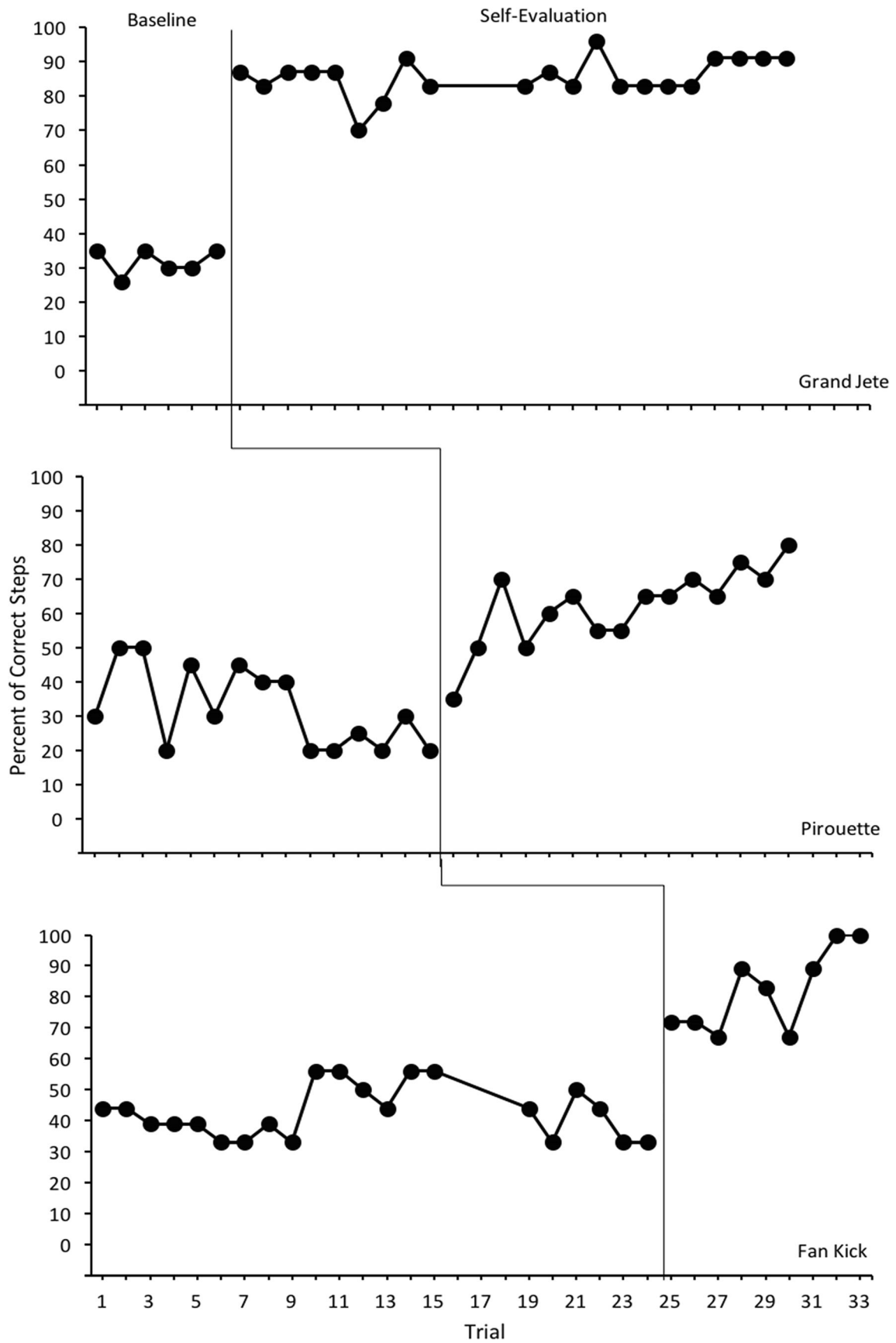


Fig. 3 Self-evaluation data for Kyle for grand jeté, pirouette, and fan kick

**Table 1** Student social validity questionnaire results

	Amelia	Eli	Kyle
My dance skills improved after using video self-evaluation training.	Slightly agree	Agree	Agree
Using video self-evaluation helped me understand what steps of the movement I need to improve.	Strongly agree	Agree	Strongly agree
I liked using the video self-evaluation procedure.	Strongly agree	Agree	Slightly agree
I will continue to use video self-evaluation to improve my dance performance.	Strongly agree	Slightly agree	Slightly disagree
I feel more confident in my dance performance after using video self-evaluation.	Agree	Strongly agree	Agree
It was not too difficult to use video self-evaluation of my own dance move.	Strongly agree	Agree	Agree

An interesting finding from this study is that retraining was required for at least one movement for each participant. When Amelia scored lower than 80% IOA with the researcher during her fan kick self-evaluation session, retraining was conducted during the next session. This also occurred for the pirouette with Eli and the grand jeté with Kyle. This finding suggests that, although the video self-evaluation procedure was effective in increasing performance, it should be overseen by a teacher or other trained individual to make sure the students are effectively trained on the task analysis, are conducting the self-evaluation procedure correctly, and are provided with retraining when necessary. One limitation in this study was that the retraining occurred during the participants' next session, which was often a week after the previous session. Due to this delay, the feedback provided for retraining was not immediate and could result in less effective training.

The results show that video self-evaluation is a promising procedure for promoting dance skills in competitive-level dancers and is something that could be done without the need

for a dance instructor to be present. The accessibility of such a procedure is something that could be beneficial to competitive dancers in order to promote progress outside of their scheduled dance classes. The feasibility of this procedure is also an important factor to note. In the competitive dance environment, all time spent practicing one's performance is valuable to progress in the field of competitive dance. If a dancer is able to improve his or her performance during personal time, the dancer may make larger improvements as opposed to only receiving effective training in a dance class.

Additionally, all dancers reported they perceived that this intervention was successful in improving their dance performance. The participants reported they were in favor of the use of this procedure and stated that they would recommend this procedure to other dancers. The participants also reported anecdotally how the study had helped improve their dance skills. During a session, Amelia reported that she was thinking about the steps in the task analysis of the fan kick movement while she was completing the movement in class. Kyle stated that he felt the study was helping him slow down and think more about the small steps that occur during each movement. Additionally, Eli emitted statements that implied satisfaction with his improvement in his skills, such as smiling and saying "yes" to himself when he scored higher on a movement during the session. These anecdotal results suggest that the effects of video self-evaluation may be due, in part, to rule-governed behavior generated by the act of evaluating one's own videos.

Future studies should consider conducting longer training sessions and more rehearsals with the self-evaluation procedure so retraining is less likely to be needed. Longer training could also possibly lead to quicker improvement, as the participant would have a better understanding of the requirements of each step of the task analysis prior to beginning the procedure.

This study was the first that evaluated self-evaluation with competitive dance movements. The results show promise that self-evaluation could be an effective and feasible procedure for dancers to use when attempting to access more dance training outside the classroom setting. Self-evaluation also provides a way for dancers to access effective feedback without a dance instructor being present, which makes this procedure easily accessible to dance students and a beneficial way to enhance their own performance.

**Table 2** Teachers' social validity questionnaire results

Participant	Target Behavior	Phase	Mean Score	Change
Amelia	Fan kick	Baseline	3.83	
		Intervention	3.66	-0.17
	Grand jeté	Baseline	3.5	
		Intervention	4.33	+0.83
	Pirouette	Baseline	4.17	
		Intervention	5.33	+1.16
Eli	Pirouette	Baseline	3.33	
		Intervention	4.67	+1.33
	Fan kick	Baseline	3.83	
		Intervention	5	+1.17
	Grand jeté	Baseline	3.67	
		Intervention	3.83	0
Kyle	Grand jeté	Baseline	3.83	
		Intervention	3.67	-0.17
	Pirouette	Baseline	3.83	
		Intervention	4.5	+0.67
	Fan kick	Baseline	4.67	
		Intervention	6	+1.33



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## Compliance with Ethical Standards

**Conflict of Interest** All authors declare no conflicts of interest.

**Ethical Approval** All procedures performed in this study involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

**Informed Consent** University institutional review board approval was obtained, and informed consent was obtained from the parents of all individual participants included in the study.

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