Increasing Cheerleader Safety Through the Observer Effect

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by

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Abstract

Title: Increasing Cheerleader Safety Through the Observer Effect

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Cheerleading has a high rate of serious injuries, but the safety of cheerleaders has seldom been researched. Behavior analytic research has never investigated cheerleading and has rarely focused on improving the safety of athletes. The present study examined scored observations, a common intervention in the behavior-based safety literature, as a method to increase the safety of cheerleaders completing basic movements. This has previously been shown to produce the observer effect, wherein an observer’s safe behavior is increased after observing and scoring the behavior of another performer. Scored observations alone increased basic cheerleading movements to a mastery criteria for one of six applications, and behavioral skills training was added for an additional three applications. These results extend behavior analytic research to a new population, cheerleaders, and provide implications and suggestions when using behavior-based safety interventions to increase athlete safety.
Table of Contents

Abstract ................................................................................................................................ iii
List of Figures ....................................................................................................................... vi
Chapter 1 Introduction ........................................................................................................... 1
  Behavior Analysis in Sports .............................................................................................. 3
  Behavior-based Safety Processes ...................................................................................... 5
  Observer Effect ................................................................................................................. 5
    Observation Accuracy ................................................................................................... 7
    Novel Behavior ............................................................................................................. 8
Chapter 2 Method ................................................................................................................ 10
  Participants ...................................................................................................................... 10
  Setting and Materials ....................................................................................................... 10
  Dependent Variables and Measurement .......................................................................... 11
  Interobserver Agreement ................................................................................................. 13
  Research Design .............................................................................................................. 14
  Procedures ....................................................................................................................... 14
    Pre-experimental Procedures ...................................................................................... 14
    Sessions ....................................................................................................................... 14
    Baseline ....................................................................................................................... 15
    Scored Observations ................................................................................................. 15
<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>BST Sessions</td>
<td>16</td>
</tr>
<tr>
<td>Generalization Probes</td>
<td>17</td>
</tr>
<tr>
<td>Maintenance Probes</td>
<td>17</td>
</tr>
<tr>
<td>Procedural Integrity</td>
<td>17</td>
</tr>
<tr>
<td>Social Validity</td>
<td>18</td>
</tr>
<tr>
<td>Chapter 3 Results</td>
<td>19</td>
</tr>
<tr>
<td>Observation Accuracy</td>
<td>21</td>
</tr>
<tr>
<td>Chapter 4</td>
<td>23</td>
</tr>
<tr>
<td>References</td>
<td>33</td>
</tr>
<tr>
<td>Appendix A</td>
<td>45</td>
</tr>
<tr>
<td>PAR-Q Questionnaire</td>
<td>45</td>
</tr>
<tr>
<td>Appendix B</td>
<td>49</td>
</tr>
<tr>
<td>Informed Consent Document</td>
<td>49</td>
</tr>
<tr>
<td>Appendix C</td>
<td>53</td>
</tr>
<tr>
<td>Safety Checklist</td>
<td>53</td>
</tr>
<tr>
<td>Appendix D</td>
<td>54</td>
</tr>
<tr>
<td>Safety Checklist</td>
<td>54</td>
</tr>
<tr>
<td>Appendix E</td>
<td>55</td>
</tr>
<tr>
<td>Safety Checklist</td>
<td>55</td>
</tr>
<tr>
<td>Appendix F</td>
<td>56</td>
</tr>
<tr>
<td>Procedural Integrity Checklist</td>
<td>56</td>
</tr>
<tr>
<td>Appendix G</td>
<td>57</td>
</tr>
<tr>
<td>Social Validity Survey</td>
<td>57</td>
</tr>
</tbody>
</table>
List of Figures

Figure 1: Percent Correct Across Safety Targets for Olivia ................................................ 39
Figure 2: Percent Correct Across Safety Targets for Tracy ................................................. 40
Figure 3: Accuracy of Scored Observations for Olivia ....................................................... 41
Figure 4: Accuracy of Scored Observations for Tracy ........................................................ 42
Figure 5: Uncalculated Accuracy for Tracy ........................................................................ 43
Figure 6: Incorrect Safety Targets in Video Models ............................................................ 44
Chapter 1
Introduction

According to the National Center for Catastrophic Sport Injury Research (2022; NCCSIR), cheerleaders have the second-highest number of direct injuries of all athletes at both the high school and college levels. NCCSIR defines direct injuries as those associated with participation in the sport, having occurred during practice or performance. Indirect injuries, those sustained through strength training or other conditioning exercises, are also tracked through NCCSIR.

When looking only at injuries directly related to sport participation, football, cheerleading, and baseball are the top injury-producing sports for both high-school and college athletes (NCCSIR, 2022). Football and baseball are both categorized as sports by the National Collegiate Athletic Association (NCAA) and the National Federation of State High School Associations (NFHS). However, it is up to individual schools to determine whether to categorize cheerleading as either a sport or an activity. Schools that classify cheerleading as an activity would not include these students in any sporting reports, such as the total number of athletes or injury statistics. This means that not only is the exact number of cheerleaders in the United States unknown, but also that schools that do not consider cheerleading a sport do not have to follow certain requirements to maintain the safety of their athletes. The American Academy of Pediatrics called for cheerleading to be recognized as an official sport in 2012, stating that this would ensure cheerleaders have access to athletic trainers and other medical professionals (LaBella & Mjaanes, 2012).

As noted by the American Academy of Pediatrics, access to medical care is one way to increase athlete safety, but this is not the only way (LaBella & Mjaanes, 2012). The national and international organizations that oversee individual sports can set specific rules to increase safety. In 2006, the National Federation of State High School Associations introduced a rule that cheerleaders could not perform basket tosses on hard surfaces (Yau et al., 2019). A basket toss is a stunt in which three to four athletes throw another athlete
into the air. This athlete performs various body positions in the air before they are caught by their teammates. Yau et al. (2019) assessed cheerleading injuries before and after the “Basket Toss Rule” was implemented, finding that cheerleading injuries due to basket tosses decreased following this rule change. However, cheerleading injuries overall increased throughout the 15-year review. Cheerleaders can be injured in many other ways, such as during stunts (one to four cheerleaders lift a teammate in the air), or pyramids (multiple stunts that are interconnected). Injuries can also be sustained during jumps (athletes jumping into specific body positions) or tumbling (cheerleaders perform flips or other gymnastics movements). Tumbling can begin from a standing position or after taking several steps (e.g., while running). Yau et al. (2019) showed that rules and regulations can have an impact on the safety of athletes, but the increasing trend in injuries indicates that cheerleaders may be injured in a multitude of ways and additional strategies to keep athletes safe are warranted.

One way to improve athlete safety is through certifying coaches. It is possible that when athletic coaches are educated on safety as it relates specifically to their sport, athlete injuries will be reduced. Some sports offer coaching certificates, confirming that a coach has received basic training in the fundamentals of the relevant sport, including safety training (Cantu & Mueller, 2009). Cheerleading coaches can receive safety training and certification through USA Cheer, who also published the Cheerleading Safety Manual (2019). The manual states that the most important change that needs to occur in cheerleading is risk management and safety. The manual describes the importance of safety programs, explains different environmental variables that can affect safety (e.g., floors, weather when performing outside, other sports going on in the same area), and describes certain equipment that can be used to increase the safety of cheerleaders. Although training competent coaches is one important component to ensuring that they understand safety, there are many variables (e.g., athlete execution) that can impact safety (George, 2019). Education alone is unlikely to fully prevent all injuries.

Boden et al. (2003) made recommendations to improve the safety of cheerleaders. These included only performing certain skills on certain surfaces (e.g., landing mats, grass),
required strength training, and properly trained coaches. The American Academy of Pediatrics (LaBella & Mjaanes, 2012) also recommended training “spotters,” or additional athletes who stand nearby stunts (where 1–4 cheerleaders lift another cheerleader in the air), or gymnastics passes to ensure cheerleaders do not fall to the ground. While these recommendations may be beneficial, they do not address the correct execution of specific skills. This is an area that behavior analysis is especially well-equipped to address, given the success in applying behavior analytic principles with improving athlete performance in other sports.

Behavior Analysis in Sports

Behavior analytic interventions have been applied to increase athletic performance in many sports including football (Tai & Miltenberger, 2017), soccer (Capalbo et al., 2022), and rock climbing (Walker et al., 2020), but have yet to be applied to cheerleading. Within the behavior analytic literature on sports, a variety of different procedures have been evaluated. Schenk and Miltenberger (2019) reviewed studies applying behavior analytic interventions in sports from the 1960s through the 2010s. They reported that most studies utilized interventions with multiple treatment components, such as combining video modeling and feedback. For example, Walker et al. (2020) used a video modeling and video feedback procedure to improve the rock-climbing skills of participants. This involved showing the participants, who had limited rock-climbing experience, a video model of an expert performing the target skill beside a video recording of the participant performing the same skill. However, these authors explicitly stated that their selected behaviors were not related to safety.

Individual intervention components targeting athlete behavior have seldom been investigated alone. Capalbo et al. (2022) evaluated the effects of video modeling alone and as part of a package intervention to increase soccer skills to participants. Across all players, feedback was required to reach mastery criteria, suggesting that video modeling alone may be inadequate to teach the complex behaviors involved in sports. All participants except for one required feedback prior to achieving mastery criterion. This shows that the efficacy of
Various interventions may be idiosyncratic across behaviors and participants, calling for additional research to determine under what conditions these types of interventions might be most useful.

One area where behavior analytic research in sports is lacking is in safety. Most data on sports safety comes from injury reports, and many safety recommendations are non-behavioral, such as training coaches on the importance of safety and performing medical exams prior to participation in sports activities (Cantu & Mueller, 2009). A few studies have addressed athlete safety directly. Tai and Miltenberger (2017) used behavioral skills training (BST) to teach football players to follow a safer protocol for tackling. This study was a replication of Stokes et al. (2010), who emphasized both performance and safety through the use of a task analysis of safe tackling and differential reinforcement. Although these participants increased their correct tackles, Stokes et al. (2010) did not explicitly state the effect their intervention had on safety. Tai and Miltenberger (2017) exclusively evaluated the safety of the players tackling behaviors, which became significantly safer through the BST intervention. Another study that explored both safety and performance in football players was Harrison and Pyles (2013). This research did not focus exclusively on the safety of players but used verbal instructions and shaping to improve tackling. The authors noted that this behavior impacts both the performance of the team and the safety of the player. Tackling improved for the participants, suggesting that their safety when engaging in the target behavior may have also improved.

Behavior-analytic research has also improved the safety of soccer players. Quintero et al. (2020) taught soccer players to engage in safe “heading” or bouncing the soccer ball off the head through BST. These researchers created a 14-step task analysis of the safety skill and provided instruction, modeling, rehearsal, and feedback. Following intervention, the participants significantly improved their adherence to the task analysis. Although effective, BST may require a greater response effort than a typical athletic coach is able to provide. Reducing response effort is a common factor in applied behavior analytic interventions, such as those used in the workplace. Interventions that require higher response effort are
Behavior-based Safety Processes

Behavior-based safety (BBS) was initially introduced in the 1970s, quickly becoming popular for organizations looking to decrease accidents (Cooper, 2009). BBS focuses on safe behavior performed by employees, targeting interventions in the environment (e.g., removing barriers to safe performance) and at the performer level (e.g., teaching safe performance). This process often measures deviations, or near misses, from safe performance, as injuries occur less frequently than near misses (Alavosius & Burleigh, 2022).

A great deal of research has been conducted to determine the most efficient BBS process in applied workplaces. The BBS process most often consists of identifying the behaviors associated with safe performance, creating an observation program, evaluating the data from observations, and giving feedback to employees (Alvero & Austin, 2004; Alvero et al., 2008; Cooper, 2009; DePasquale & Geller, 1999; Gravina et al., 2008; King et al., 2018; Sasson & Austin, 2005). Although there are many interventions that may be used within the BBS process, observations are essential to the overall process (Cooper, 2009). Observations often consist of an observer (e.g., peer, supervisor) observing and providing feedback on a performer’s (e.g., supervisee, trainee) behavior. This is often done by filling out a safety checklist, which lists the essential aspects of the performance. Observations have been widely accepted as an essential piece of the BBS process because of the direct contingencies on the performer’s behavior. However, the process of an observer conducting observations has also been shown to influence the observer themselves.

Observer Effect

Peer observations and subsequent feedback can improve the performance of the employees being observed (Cooper, 2009). However, research also shows that conducting
observations can influence the behavior of the observer. The improvement in performance of the observer was originally termed the observer effect by Alvero and Austin in 2004. Interventions capitalizing on the observer effect typically require an individual (the observer) to observe a behavior and collect data using a checklist or data sheet prior to performing the behavior themselves. After completing observations of the behavior, the observer may then show improvements in performance when asked to engage in the behavior. Applied applications of the observer effect often utilize a live model for observations, asking an employee to observe and score a coworker conducting a job-related task (e.g., Howard et al., 2013; Thomas, 2013). Research applications of the observer effect may ask participants to observe and score a video model as well (e.g., Alvero & Austin, 2004; King et al., 2018).

It is theorized that the observer effect is produced when the observer learns to self-monitor and self-evaluate their own behavior, causing an improvement following their observations (and scoring) of another person’s performance. Experiments to identify the observer effect ask an observer to conduct an observation, which includes a checklist. The observer is then asked to perform the same behavior they observed. This intervention will be referred to as scored observations. In the first experiment that utilized scored observations to demonstrate the observer effect, Alvero and Austin (2004) asked participants to collect data on a confederate peer’s proper posture during simulated workspace tasks such as lifting boxes, typing, sitting at a computer, and answering a phone. Participants were then asked to perform these workspace tasks themselves. Researchers found that the participants’ posture improved after they began conducting safety observations on confederate peers. Other researchers have found scored observations to be effective in increasing safe behavior in the workplace as well as the research lab (e.g., Alvero et al., 2008; King et al., 2018; Sasson & Austin, 2005).

Research on scored observations has not been limited to safety applications. Several research groups have utilized scored observations in health and human services and educational settings (e.g., Blackman et al., 2021; Thomas, 2013). In these settings, scored observations have been found to be effective at increasing treatment integrity (Howard et
al., 2013; Thomas, 2013) and at improving interactions between staff and clients in residential treatment facilities (Guercio & Dixon, 2011). Williams and Gallinat (2011) successfully capitalized on the observer effect when certain aspects of discrete trial teaching (DTT) were not being implemented at the mastery criterion after initial training. In each of these studies, participants’ behavior was improved after conducting observations and collecting data on another individual’s performance.

The observer effect has been demonstrated by many studies (e.g., Alvero & Austin, 2004; Howard et al., 2013). Although there have been investigations across various settings (e.g., health and human services, office work), the observer effect has never been produced in a sports setting.

Observation Accuracy

Whereas many studies have demonstrated support for the observer effect, certain components may increase its effectiveness. As seen in Blackman et al. (2021), manipulations relating to the accuracy of observations may increase the robustness of the observer effect. This has been measured in other studies with varying results (Alvero et al., 2008; Field et al., 2005; Romer et al., 2021; Sasson et al., 2005). Sasson et al. (2005) and Alvero et al. (2008) found no correlation between the accuracy of the observation and the impact on safe behavior. Marano et al. (2020) directly manipulated accuracy with positive results. Researchers taught participants to conduct paired-stimulus preference assessments using an online training program. After viewing a video model, participants were asked to select whether the individual step was completed correctly. Accurate responding produced an explanation of what specifically had been done correctly or incorrectly prior to moving to the next video model. Participants viewed novel clips without feedback before performing preference assessments themselves. All participants reached 100% correct implementation within two trials with a confederate client and maintained the skill across novel items and clients.

There are a few key differences between the groups who found no correlation between accuracy of observations and increase in performance (Alvero et al., 2008; Sasson &
Austin, 2005) and those who did (Blackman et al., 2021; Marano et al., 2020). Each study that found no correlation between observation accuracy and the effect on behavior was attempting to improve known skills. They also measured accuracy rather than directly manipulating it. The observer effect is theorized to function through self-monitoring, an intervention in which an individual observes and evaluates their own behavior (King et al., 2018; Olson & Winchester, 2008). When teaching a novel skill, self-monitoring can only be effective if the learner monitors the correct aspects of the skill. Research has suggested that accurate feedback contributes to skill acquisition (Lipschultz et al., 2021). With scored observations and with self-monitoring, feedback is self-generated. The more accurate this self-generated feedback is, the better the skill acquisition should be. Marano et al. (2020) and Blackman et al. (2021) both manipulated their training procedures to ensure participants were delivering accurate feedback in observing video models.

An additional difference between studies is that the studies that found a correlation between accuracy and behavior required participants to complete observations a single time. They were also teaching clinical skills. Safety research shows that frequent observations produce greater behavior change (Spigener et al., 2022). When teaching novel safety behavior, it is likely that observations will need to be both frequent and accurate.

**Novel Behavior**

Much of the previous research on scored observations has targeted behaviors already in participants’ repertoires, such as sitting properly at a desk or performing components of DTT (Alvero et al., 2004; Williams & Gallinat, 2011). One study that targeted the acquisition of novel skills is Romer et al. (2021). Researchers taught participants to conduct discrete trial instruction. Participants completed an online module that manipulated accuracy within scored observations. After viewing a video model, participants were required to correctly answer questions about the performance before moving to the next video model. Following training, all participants met mastery criterion within four sessions.
Field et al. (2015) also used scored observations to teach a novel skill to participants. Researchers taught functional analysis (FA) methodology to students. Participants observed and scored performance on video models before performing an FA themselves. Sixteen of 17 participants increased from baseline with this intervention alone, but seven participants required another intervention to reach mastery criterion. This additional intervention was a self-observation; participants viewed a recording of their own performance instead of a video model. Of the seven participants who received this intervention, five reached mastery criteria. Those that did not reach mastery declined additional training.

To the author’s knowledge, scored observations have thus far only been used to teach novel clinical behaviors. Novel safety behaviors have not been taught. When the observer effect has been demonstrated in a safety context, participants have increased the frequency or accuracy of previously known behaviors (e.g., Alvero & Austin, 2004; King et al., 2018). Additionally, safety and sports research have remained separate entities. Sports research has primarily focused on improving the accuracy or performance of certain skills, though data show that athletes are at high risk of injuries (NCCSIR, 2022). Very few research articles have focused on decreasing injuries and increasing the safe behaviors that athletes engage in. Behavior analysis has a unique ability to reinforce basic athletic skills that will result in reduced injuries. Drawing upon the safety literature available, researchers can use this as a starting point for assessing interventions to increase safety for athletes. The present study seeks to combine research on the observer effect with cheerleading, a new sport to behavior analytic research. Participants will be taught basic, novel cheerleading skills that will increase their safety through conducting observations of video models. Therefore, the purpose of the present study was to assess the effects of conducting scored observations on cheerleading safety targets of adults in a lab setting.
Chapter 2
Method

Participants
A total of two adults were recruited for this study from students within behavior analysis programs and word of mouth at a university in the southeastern United States. Recruitment involved the primary researcher announcing the opportunity at the beginning of class sessions and emailing a recruitment flyer. Potential participants were informed that the research is about cheerleading, and they were offered training on research decisions at the conclusion of the study. Participants were included in the study after they had successfully completed and passed the Physical Activity Readiness Questionnaire for Everyone (PAR-Q; Warburton et al., 2011; see Appendix A). This is a self-report questionnaire that assesses an individual’s ability to safely increase their physical activity. The PAR-Q asks about issues such as heart conditions or chronic health conditions and advises individuals to either participate in physical activity or speak with a medical professional. The present study only included individuals who had successfully passed the PAR-Q or received a physician’s approval for participation. After participants completed and passed the PAR-Q questionnaire, they were emailed an informed consent document (see Appendix B). This was collected from the participants prior to participation in the study. Demographic information was not collected from the participants.

Setting and Materials
This study took place in a clinical observation room within a university. Materials included a yoga mat, 8-lb (3.63 kg) dumbbell, two GoPro cameras, two tripods, video models displayed on an iPad, data sheets, and pens or pencils. The yoga mat was laid out on the floor without furniture within 1 m of the mat. One GoPro was positioned to record the participant’s movements from the front, and the other GoPro recorded the participant from their left side. The participant and researcher were present.
All video models depicted the safety targets alongside two other movements (non-target behavior) involving the arms or shoulders. The targets plus additional movements are referred to as a choreographed sequence. Each movement or behavior within the choreographed sequence was associated with two numbers in a count of eight. Most choreography in a cheerleading routine is grouped by counts of eight. For the “base” sequence, the audio for a video model said “one two” at the same time the experimenter was depicted raising both shoulders. When the audio said, “three four”, the experimenter was shown engaging in safety target A1. When the audio said, “five six”, the experimenter was shown engaging in safety target A2. When the audio said, “seven eight”, the experimenter was shown bringing the dumbbell down to the hips. Each safety target had a different choreographed sequence.

Dependent Variables and Measurement

The primary dependent variable was the percentage of safety targets performed correctly, as measured by three safety checklists (see Appendices C, D, E). Each checklist included 10 safety targets, which were described by written definitions and with pictures depicting safe performance from the front and side view. The ten targets combined to create a two-step movement, such as squatting and then standing. The safety targets were selected because they are movements that a cheerleader would need to safely perform on a regular basis. For the present study, the most basic cheerleading movements were selected as safety targets. These movements create the building blocks to more advanced cheerleading stunts (in the case of checklists A and C) or tumbling (in the case of checklist B), which, if performed incorrectly, could lead to serious injury. As the present study utilized participants with little to no cheerleading experience, the current safety targets are unlikely to cause injury. However, these safety targets were selected because they present safety risks in an applied setting.

Safety targets were validated by a college-level cheer coach in the Midwestern United States prior to recruitment for this study. After data collection began, experimenters discovered that the approved safety checklists were not appropriate for all body types,
including one of the participants in the study. Item number five on safety checklist B1 (see Appendix B) stated that the feet should be shoulder-width apart prior to jumping in the air. When approving the checklists, the cheer coach explained that feet needed to be relatively close together to be considered safe for this behavior. Most cheerleaders are female, and the average female body has wider hips than shoulders. The approved checklist stated that feet should be shoulder-width apart, as this would result in the feet being positioned somewhat close together in this behavior. Upon discovering that one of the participants in the study had wider shoulders than hips, the checklist was changed to state that feet should be “about hip-width apart” to ensure that no participant was asked to hold their feet so far apart that it is considered unsafe.

One example of a safety target is item number one on checklist A1, which is the safety target “base” (see Appendix C). When correctly executed, this involved the participant properly gripping the dumbbell with both of their hands in the squatting position, as shown in the safety checklist for this behavior. This would be marked as incorrect if a participant used one hand to grip the dumbbell, held the dumbbell in the center, or did not complete the full choreographed sequence. When a cheerleader completes this movement, they are lifting another athlete in the air. It is important that they correctly position their body in the squatting position and while holding their teammate in the air to ensure the safety of everyone involved in the stunt.

Another example of a safety target is item ten on safety checklist B2, the safety target “standing tumbling” (see Appendix D). When correctly executed this looks like feet remaining close together during the jump. This would be marked incorrect if feet are more than shoulder width apart during the jump. In the applied setting, this is the step immediately before a cheerleader completes a gymnastics skill. Depending on the difficulty of the particular skill, a cheerleader may flip upside down with or without the use of their hands. It is essential that cheerleaders start these skills correctly, so they are able to land firmly on their feet.
Safety checklist C2, “flyer” (see Appendix E), includes safety target number nine. When correctly executed, this target includes connecting the right foot to the left knee. This would be marked as incorrect if the heel of the right foot was touching the bottom of the bottom of the left knee. In a practice or performance setting, this safety target would be completed by a cheerleader who has been lifted in the air by their teammates. The flyer’s ability to balance their body is important to ensure they stay safely in the air without falling.

Dartfish © software was used outside of sessions to score videos of participants performing the skills. This allowed researchers to pause a video and objectively measure safe and unsafe performance. For example, item number two on safety checklist A1 (see Appendix A) requires that participants bend their elbows to 90 degrees. Using the Dartfish © angle tool, experimenters were able to measure the angle to ensure participants exactly met the criteria.

A secondary dependent variable was the accuracy of the observations, as measured by the safety checklists (see Appendix C, D, E) that participants filled out while observing a video model of the safety targets. The accuracy of observations was measured by comparing the participant’s scored checklist with a key created by the researcher.

**Interobserver Agreement**

Interobserver agreement (IOA) was collected on a minimum of 20% of randomly selected sessions by an independent observer. Interobserver agreement data were collected by viewing the session video recording. Once the independent observer reached 100% accuracy on scoring three consecutive video models, they began scoring participant videos. Trial-by-trial IOA was computed by calculating the number of agreements on a safety checklist. An agreement was defined as both observers marking either a 1 (signifying a correctly completed safety target) or marking a 0 for an incorrect safety target. A disagreement was defined as one observer marking a safety target as correct and one observer marking the same safety target as incorrect. The formula used was the number of
agreements divided by agreements plus disagreements multiplied by 100. If IOA scores fell below 80%, retraining occurred. IOA for Olivia was 86% overall, with 87% agreement for “base”, 85% agreement for “standing tumbling”, and 86% agreement for “flyer”. IOA for Tracy was 87% overall, with 84% agreement for “base”, 93% agreement for “standing tumbling”, and 86% agreement for “flyer”.

Research Design

This study followed a concurrent multiple baseline across behaviors design where the introduction of the intervention was staggered across behaviors (Kazdin, 2021). Phases consisted of baseline, observation, behavior skills training (BST), generalization, and maintenance probes. Participants only moved to the next phase when all of the behaviors being measured were stable, except when experimenter errors occurred. All participants were shown video models in a random order.

Procedures

Pre-experimental Procedures

Inclusion criteria ensured the participants had little-to-no experience with the safety targets, while exclusion criteria ensured the targets were truly novel behaviors. The first safety target to enter intervention was randomly selected, with the other targets entering intervention in a pseudo-randomized order. If one safety target had a significantly lower baseline than another, this was selected as the next safety target to enter intervention.

Sessions

A single session consisted of one video model being watched and one safety target being performed. Scored observations were conducted by participants in all phases except the baseline phase. Sessions lasted between 1-5 min. Participants were asked to perform a safety target immediately before or after completing two arm movements (i.e., choreography). This simulates a choreographed cheerleading routine, in which cheerleaders complete a variety of skills in a short period of time. As in a typical
cheerleading routine, some of the performed skills were related to safety (see Appendices C, D, E) and some of the performed skills were not related to safety (e.g., arm movements or “motions”). A minimum of three sessions were completed each day, at least one session per safety target. In any given day, between four and twelve sessions were completed. After all data was collected for a day, each session video was uploaded to Dartfish © software for scoring.

Participants were periodically asked about their physical condition, and breaks were given between sessions if participants indicated that they needed to rest. Water was available to participants via a drinking fountain just outside the clinical observation room where sessions were held. Participants were reminded regularly that they could request to withdraw from the study or end data collection for any particular day at any point.

**Baseline**

Baseline sessions consisted of showing a video model depicting a choreographed sequence containing one embedded safety target. Baseline video models did not depict programmed errors. As participants were novice cheerleaders, they were only shown correct performance during this phase to minimize risk. Each safety target was embedded within a separate choreographed sequence. Participants were told that they can watch the video model two times before they copied the video model. The experimenter asked the participant to pay attention to things that may influence the safety of an athlete, such as the position of their legs or back. While participants were not given safety checklists until the scored observation phase, they were informed that the study was meant to improve safety. Participants were given no feedback for performances. Immediately before a safety target moved into intervention, the researcher conducted a preassessment of the generalization probe.

**Scored Observations**

Scored observation sessions consisted of the first author giving the participant the safety checklist (see Appendices C, D, E) and allowing time to review the checklist. Participants
were then asked to watch a video model up to two times. Participants were asked to score a safety checklist (see Appendices C, D, E) while watching the video model or immediately following the video. During intervention, video models included up to two random mistakes. The mistakes consisted of incorrect examples of the items on the safety checklists (see Appendices C, D, E). Each item on the safety checklist was performed incorrectly in at least one video model. Mistakes were not pointed out to participants, who were instructed to indicate incorrect safety behavior on the safety checklist (see Appendices C, D, E). Participants were then asked to perform the sequence shown in the video model safely. Performances were scored by an experimenter using the same safety checklist (see Appendices C, D, E) that participants used to score video models. Participants were given at least one opportunity to score and perform each safety target per day of data collection. At the conclusion of a session, participants initialed and dated their safety checklists (see Appendices C, D, E), which were then scored for accuracy by the first author.

Mastery criteria were set at 100% accuracy across three consecutive sessions, so long as these sessions span at least two days of data collection. High mastery criteria were chosen due to the target behaviors being safety targets.

**BST Sessions**

For any behaviors that did not meet mastery criteria during the scored observation phase, BST sessions were held. This was necessary for three behaviors. These sessions consisted of the first author asking the participant to read the safety checklist (see Appendices C, D, E), and then showing how to properly hold their body based on these checklists. The experimenter then gave feedback on the body positioning until the participant was able to correctly hold their body. The participant practiced safe body positioning several times throughout the BST sessions, which lasted an average of 17 minutes. After the BST session, subsequent sessions followed the same format as scored observation sessions.
Generalization Probes

Generalization probes were conducted periodically during the study. Except when experimenter errors occurred, generalization probes were conducted prior to participants beginning scored observations. Generalization probes were also conducted following the last observation session, as time allowed. In these probe sessions, participants scored a video model of the same safety target performed within a novel choreographed sequence. Participants were then asked to copy the video model and their performance of the safety targets was scored. If participants did not follow the choreographed sequence shown in the generalization video model, clarification was provided, and another generalization probe was conducted. Prior to leaving generalization probes, participants were asked to initial and date their safety checklists (see Appendices C, D, E), which were then scored for accuracy. Participants were given no feedback on their performance.

Maintenance Probes

Maintenance probes were conducted at least seven days following participants reaching mastery criteria (with the exception of Olivia’s “base” maintenance probe). Participants were asked to score a video model of the safety targets within the original choreographed sequence. Participants were then asked to copy the video model and their performance of the safety targets was scored (see Appendices C, D, E). Prior to leaving the maintenance check, participants initialed and dated their safety checklists (see Appendices C, D, E), which were then scored for accuracy. Participants were given no feedback on their performance.

Procedural Integrity

Procedural integrity was assured by showing all video models in a predetermined, random order, eliminating potential sequence effects. Participants initialed and dated the safety checklists they filled out during observation and generalization probes. Procedural integrity data were collected on a minimum of 20% of randomly selected sessions via a Procedural Integrity Checklist (see Appendix F). If this data dropped below 80%, retraining occurred. Procedural integrity was 89% for Olivia and 94% for Tracy.
Social Validity

Following the completion of the study, all participants were emailed a social validity survey (see Appendix G). This was sent following the last data point. The survey asked a total of 9 questions, each rated on a 5-point Likert scale. Olivia gave an average score of 4.78. Only two items scored 4/5. These items asked about increased confidence after performing the skills and the ease of copying the video models. Tracy gave an average score of 3.88. Tracy’s lowest rating was given to the item asking whether completing observations increased confidence in completing the behaviors, and her highest rating suggested that conducting observations made her more aware of her behavior.
Chapter 3
Results

Olivia’s performance on safety target A, “base”, averaged 46.6% in baseline (see Figure 1). Three baseline sessions were run for “base”. Performance in this phase ranged from 40-60% safe. Due to experimenter error, there was no generalization probe conducted, and intervention began on an increasing trend. After Olivia began conducting scored observations for “base”, the increasing trend continued, peaking at 90% correct performance. Olivia scored 60% immediately after the generalization probe was conducted for safety target B, “standing tumbling”. Prior to this point, behavior had been stable at 80% and went back up to 90% correct immediately after. There were 21 scored observation sessions for “base”, ranging between 60 and 90% safe. When safety target A failed to reach mastery criteria with scored observations, a BST session was held for “base”. Following this session, behavior reached 100% correct. Four trials were run after the BST session, and all scored 100% correct. Two generalization probes were conducted after Olivia reached mastery for “base”. Both probes scored 90% safe. During the first generalization probe, Olivia followed the choreographed sequence from the previous video models. After clarifying that she was to follow the new choreography, another probe was conducted. Due to time constraints, a maintenance probe was conducted three days later, and Olivia scored 100% safe. This probe came immediately after a BST session for “standing tumbling”.

Olivia’s baseline performance on safety target B, “standing tumbling”, scored an average of 77.5% throughout the phase (see Figure 1). Performance in baseline ranged from 70-90% correct, and eight sessions were run. After behavior had stabilized, a generalization probe of “standing tumbling” was conducted. This probe scored 30% correct. Olivia began conducting scored observations for “standing tumbling”, with an average score of 77.64% in this phase. The first two trials after Olivia began conducting scored observations were the lowest of the phase, scoring 40% and 50% safe, respectively. Excluding these two data points, the average score for this phase was 82.3%. Scores during the observation phase ranged from 40-90% correct, and 18 total sessions were run in this phase. Immediately after the BST session for “base”, performance for “standing tumbling” increased to 90%
safe, then dropped back down to 80%. After this had stabilized, a BST session was held for “standing tumbling”. Olivia scored 100% correct after the BST session, though time constraints did not allow for multiple days of data collection following the session. One more data point would be necessary for Olivia to reach mastery for “standing tumbling”.

Olivia’s baseline performance on safety target C, “flyer”, scored an average of 86.6% correct (see Figure 1). Performance during this phase ranged from 80-90% correct, and 12 total sessions were run. After the data were stable, a generalization probe of “flyer” was conducted. This probe scored 60%. Olivia averaged 96% correct during scored observations of safety target C, “flyer”. The range for this phase was 80-100% correct, with ten total sessions. While there was no increase from baseline with the first scored observation, “flyer” was the only behavior to reach mastery criteria with scored observations alone. A maintenance probe scored 100% correct, as did the first generalization probe, where Olivia followed the original choreographed sequence. After clarifying that she was to follow the new choreography, Olivia scored 90% safe on a generalization probe.

Tracy’s baseline performance for safety target B, “standing tumbling”, ranged from 70-90% correct, with average performance at 80% safe (see Figure 2). There were three sessions in this phase. When Tracy began conducting scored observations, performance immediately decreased to 60% correct, though average performance for this phase was 77.7%. Performance during scored observations ranged from 30-100% correct, and 18 sessions were conducted. Performance for this phase was highly variable, with the last data point as the lowest performance for the phase. When behavior failed to stabilize and continued to decrease, a BST session was held for “standing tumbling”. Following this session, behavior immediately increased to 100% correct, but subsequently decreased to 90% and 60% correct. At this point, Tracy disclosed a medical condition that would have excluded her from participation in the study, had it been noted on the PAR-Q (Warburton et al., 2011; see Appendix A). Tracy was released from further participation at this point to protect her health.
Tracy’s baseline performance for safety target C, “flyer”, ranged from 10-20% correct, with a 15% average score (see Figure 2). Eight sessions were run during baseline for “flyer”. This behavior requires participants to stand on one leg, and Tracy used the wrong leg during this phase. Tracy scored 0% on the generalization probe for “flyer” before starting scored observations. When Tracy began scored observations, she did not begin using the correct leg until the second observation. The average score for scored observations was 72.7% correct, ranging between 20-90% correct. A total of eleven scored observation sessions were done for “flyer”.

Tracy’s baseline performance for safety target A, “base”, ranged from 30-70% safe (see Figure 2). The average score for this behavior was 61.4%. As the last behavior to begin scored interventions, “base” remained in baseline for the longest period. Following an initial increasing trend, behavior somewhat stabilized after the fifth performance of “base”. Fourteen sessions were run during baseline for “base”. A generalization probe was conducted of “base” with a 50% correct score. Upon beginning scored observations, Tracy scored 60% correct. Scores for this phase ranged from 50-80% correct, with an average score of 65% correct. Though the average score for this phase is higher than baseline, behavior peaked early in the phase and continued to decrease with more scored observations. Eight sessions were run during this phase.

**Observation Accuracy**

Figures 3 and 4 depict the percent of accurate observations for each participant. There are no data depicted during baseline phases, as participants did not fill out safety checklists (see Appendix C, D, E) during this phase. The accuracy of observations is not consistent for either participant. Olivia shows a smaller range for accuracy of “base” and “standing tumbling”, with more variability as it relates to “flyer” (see Figure 3). However, Olivia was 100% accurate with 5 of 13 scored observations of “flyer”.

Some accuracy data were unable to be calculated for Tracy due to experimenter error (see Figure 4). For two different days of data collection, the order that checklists were
completed was unknown. Thus, it is uncertain which accuracy checklists corresponded to the conducted sessions. Figure 5 depicts the possible data points for accuracy based on the video models shown on those dates. Just before the BST session for “standing tumbling”, there was an increase in accurate scored observations. However, the only 100% accurate observation for “standing tumbling” correlates with the lowest performance for this behavior. When Tracy was the most accurate in scoring “standing tumbling”, she was the least safe in her actual performance.

The observer effect relies on accurately discriminating between safe and unsafe performance. Participants were unable to consistently demonstrate accuracy when conducting observations, suggesting that they were unable to correctly discriminate between safe and unsafe performance.
Behavior analytic research has not been conducted within the sport of cheerleading (Schenk & Miltenberger, 2019). Research regarding athletic performance has increased, but few studies have focused exclusively on safety (Quintero et al., 2020; Tai & Miltenberger, 2017). Athletes frequently sustain injuries, and behavior-analytic interventions may be an effective method of increasing safety and thereby reducing injuries. One important consideration when attempting to increase safety is the ability to implement the procedures in a typical practice environment. Low-response effort interventions are more likely to be reliably used in the applied setting, as they require little effort to be effective. Thus, the purpose of the present research study was to evaluate the observer effect within cheerleading.

Participants completed scored observations of video models before performing basic cheerleading skills themselves. The observer effect would have been shown if there was a distinct difference between performance when observing a video model alone and performance after conducting a scored observation. Scored observations alone failed to increase safety to the mastery criteria for five out of six evaluations. Two behaviors met mastery criteria following a BST session that included modeling, feedback, and practice. Though the observer effect was not demonstrated, this research is still valuable moving forward in evaluating behavior-based safety (BBS) interventions as a method of increasing athlete safety.

After conducting scored observations, performance on safety targets did not increase to the necessary levels, with one exception. There are many possible reasons that scored observations alone failed to produce the observer effect. These may range from the difficulty of safety checklists, the ability to discriminate between safe and unsafe performance, the complexity of the desired skills, or other reasons. Considerations will be
discussed in more detail, and future research should be conducted to identify efficient ways to increase athlete safety.

Participants in this study reported that the checklists were difficult to follow upon introduction. Immediately after the first scored observation for “standing tumbling”, Olivia did not complete her performance of the skill. She began the first part of the safety target by putting her hands close to her body and correctly positioning her feet but did not complete any other part of the safety checklist. Olivia gradually improved her performance, but the initial introduction of the safety checklist significantly decreased her safe performance. The skills used in this study are simple enough that injury is unlikely due to unsafe performance. However, there is a significant risk of injury in the applied setting and when learning more complex movements after these basics are mastered. Future research should investigate gradually introducing safety checklists to ensure safety is impacted in a positive way rather than what was seen in this study.

It is also possible that participants in this study did not fully attend to the checklists, which may have affected the ease of implementing safe behavior. While completing the second scored observation for “flyer”, Tracy said that “it helps to read these (checklists) super carefully”. Immediately following this scored observation, Tracy’s performance increased from 20% correct to 70% correct. This significant increase may be related to the simplicity of the behaviors in need of change. Prior to this point, Tracy had been standing on her right leg, which is incorrect according to the safety checklist (see Appendix C). Upon introducing scored observations, Tracy continued to stand on her right leg. After this session, however, she switched to her left leg. During baseline, Tracy’s behavior was controlled solely by the video models. Upon the introduction of the safety checklists, it is possible that the video models continued to exert control over her behavior. In the video models for “flyer”, the experimenter followed the safety checklists exactly by standing on the left leg and lifting the right leg. When watching the video models, the bent leg was on the left side of the screen. This is commonly known as “mirroring”. It is the same phenomenon that causes text to read backwards when looking in a mirror. When participants asked which leg to use in this skill, they were told that the videos were not
mirrored, meaning that participants should use the opposite leg as the one they see being used in the video. Future research may need to use more explicit instructions to increase the stimulus control of the safety checklists.

After data for “flyer” had stabilized, Tracy began scored observations for “base”. The first time she was handed this safety checklist, Tracy began reading aloud the safety targets. She also picked up the dumbbell (which was sitting on the table) and began manipulating the dumbbell to match the written instructions for holding it correctly. While overall performance on “base” decreased slightly after scored observations began, Tracy’s hand position was correct immediately after completing her first scored observation. She only held the dumbbell correctly once during baseline but held it correctly the first three performances after beginning scored observations. After three performances, Tracy did not correctly hold the dumbbell. It is possible that correct performance could have been maintained for this behavior by including feedback, though this would need to be confirmed through further research.

It may have been difficult for participants in this study to discriminate between safe and unsafe performance in video models. The provided safety checklists included written instructions and photos of safe performance, but these may not have been sufficient to teach the appropriate discrimination. Additionally, Olivia reported on multiple occasions that she was trying to picture angles. The checklists for “base” and “standing tumbling” both listed that knees should be bent between 80-110 degrees. While the photo on the checklist depicted the knees bent within this range, only one photo was used. Participants were not provided with additional instructions or visual representations of safe performance related to the degree to which knees should be bent or photos depicting body positions from different angles. Some studies using scored observations have included a training phase that taught participants to accurately discriminate between safe and unsafe performance (e.g., Blckman et al., 2021; Marano et al., 2020; Romer et al., 2021). These accuracy trainings have not always resulted in a difference in performance, but future research may investigate these findings in athletics setting.
Another limitation of the present study is the possibility of behavioral interactions. Across the checklists for “base” and “standing tumbling” (see Appendix A and B), there are a few similarities. Both checklists ask the participants to hold a straight back while in a squatting position and an upright position with the hands above the head. While squatting, “base” asks the participants to hold their shoulders above their hips, whereas “standing tumbling” allows the participants to hold their shoulders over their thighs. “Base” then asks participants to maintain a straight back while lifting a weight above their head. “Standing tumbling” asks participants to keep their backs straight while jumping straight up with their arms above the head. The behaviors are slightly different, but they may have been interdependent.

Olivia began conducting scored observations for “base” first, and the graph shows no difference in “standing tumbling” performance immediately after beginning these scored observations. Olivia showed a decrease in safe “base” behavior following the generalization probe for “standing tumbling”, but an increase in safe behavior after scored observations were introduced for “standing tumbling”. This increase was higher than the previous steady performance but was not Olivia’s highest-scoring performance at that point. There is also a slight increase in Olivia’s “standing tumbling” performance after the BST session for “base”, though this is not the highest-scoring performance for “standing tumbling”. After meeting mastery criteria for “base”, Olivia completed two generalization probes for this behavior. She scored 90% correct for both of these. The next time she completed this behavior was after a BST session for “standing tumbling”, and her performance again reached 100% correct. This increase may have been influenced by the BST session.

Tracy also showed a possible correlation between “standing tumbling”, “base”, and generalization probes. Immediately after a generalization probe for “base”, Tracy’s performance for “standing tumbling” was the lowest scoring performance up to this point, though it was her 15th scored observation. The next scored observation for “standing tumbling” saw a significant increase. This came after the first scored observation for
“base”. However, Tracy’s performance of “base” following her first scored observation scored lower than baseline performance for this behavior.

While Tracy did not complete a generalization probe for “standing tumbling” due to experimenter error, there is a possibility that the introduction of scored observations for this behavior influenced her performance with the “base” behavior. When “standing tumbling” scored observations were introduced, performance for “standing tumbling” was on a decreasing trend, and behavior for “base” was on an increasing trend. The increasing trend continued following the introduction of the safety checklist, though safe performance for “standing tumbling” did not immediately increase. The increase in “base” may have been influenced by the safety checklist, though “standing tumbling” did not begin to increase until the second scored observation was conducted. Any interactions between behaviors need to be further investigated by future research.

Practice effects cannot be eliminated as a contributor to participants’ increases in safe behavior. This refers to an increase in performance as a result of repeated exposure to a task (Field et al., 2015). Practice effects can become more difficult to eliminate when performance is not stable before implementing an intervention. An experimenter error led to Olivia beginning scored observations when the relevant behavior, “base”, was on an increasing trend. This creates a threat to the internal validity of the study, as the increasing trend could have been influenced by practice effects, scored observations, a combination of the two, or some other confound.

The largest unforeseen limitation of the present study is Tracy’s undisclosed medical problem. Tracy successfully passed the PAR-Q (Warburton et al., 2011) and completed the informed consent document prior to participation in the study (see Appendix A and B). The PAR-Q does ask whether participants have any medical conditions that may be worsened by physical activity, but Tracy stated upon being released from participation that she did not closely read the PAR-Q. The informed consent document also notes that participants can withdraw at any point in the study, and participants were asked each day if they felt physically capable of completing the session.
Regardless of Tracy’s nondisclosure, her data must be interpreted with caution. After a BST session for “standing tumbling”, Tracy disclosed a long-term spine-related malformation. Immediately after the BST session (prior to the disclosure of the medical problem), Tracy scored 100% correct for the first time. The next two performances scored 90% and 60% correct, respectively. After this last data point, Tracy disclosed her spinal problem and revealed that she was in physical pain after the session. It is possible that Tracy’s pain contributed to the decreasing trend in behavior following the BST session. The variability seen in Tracy’s graphs may have also been impacted by her physical status. It is possible that she experienced issues related to meeting criteria on certain steps due to this. These issues raise the importance of working in tandem with medical professionals and trained coaches and providing ongoing evaluations of athletes.

A secondary dependent variable was the accuracy of scored observations. Due to an experimenter error, it was impossible to calculate accuracy data for six of Tracy’s observations for “standing tumbling”. Even without these data points, there is little to no correlation between accuracy and performance for either participant. This is most clearly seen when considering Tracy’s lowest-scoring performance of “standing tumbling”. This performance occurred immediately after she conducted the only observation that was 100% accurate for this behavior.

Previous research on the observer effect has shown mixed findings in relation to observation accuracy (e.g., Alvero et al., 2008; Field et al., 2005; Romer et al., 2021; Sasson & Austin, 2005). Alvero et al. (2008) and Sasson & Austin (2005) both showed no correlation between the accuracy of observations and the impact on safe behavior. Both of these studies attempted to impact safe posture. Marano et al. (2020) manipulated observation accuracy in an attempt to teach participants to conduct paired-stimulus preference assessments. This study found that accurate observations improved participants' performance. The present study attempted to increase safe behavior, as in Alvero et al. (2008) and Sasson & Austin (2005). The present study also attempted to teach a new sequence of behavior, as in Marano et al. (2020). Although there are mixed findings regarding whether accuracy of observations is needed for increased accuracy of
performance, it seems logical that there would be increased likelihood that participants would be better able to discriminate their own safe performance. Future research must be conducted to identify whether manipulating observation accuracy affects behavior, as seen in previous skill acquisition research, or not, as seen in previous safety research.

In addition to potential difficulties discriminating between safe and unsafe performance, participants may have been following the mistakes depicted in video models. Tracy specifically talked about following mistakes throughout the study, occasionally stating that she forgot to follow mistakes she had observed in the videos. The experimenter instructed participants to follow the video models as safely as possible but did not explicitly tell participants to not follow any mistakes they observed. One example of this is shown in a video model for “standing tumbling”. This particular model showed the experimenter jumping with her feet out to the side, somewhat resembling a star shape. Both Tracy and Olivia marked this incorrect on their checklists during scored observations. During the subsequent performance, Tracy moved her feet to the side in her jump, whereas Olivia kept her feet shoulder-width apart, as directed on the safety checklist.

Another example of accuracy and performance not correlating can be seen when viewing Olivia’s “base” observations. During baseline, Olivia never held the dumbbell correctly. After introducing scored observations, she held the dumbbell correctly during every single performance. However, Olivia incorrectly scored the hand placement during 37.5% of observations. Most of these incorrect observations were earlier observations, and Olivia became more accurate with this item as she continued conducting observations. Thus, future research should determine the best ways to get the observer’s behavior under the control of the operational definitions for safe behavior (i.e., safety checklist) rather than the performance of the model. It is possible that increasing accuracy, increasing the observer’s ability to discriminate between safe and unsafe performance, will have positive effects on the observer’s behavior (i.e., the observer effect).

Just as the participants in this study struggled to accurately score video models, the experimenters discovered problems with measurement during the study. Some of the
components of the selected behaviors were difficult to score. It was impossible to score participants in real time. This was the cause of the experimenter error that led to Olivia beginning scored observations for “standing tumbling” on an increasing trend. Based on visual observations, the experimenter assumed that performance was stable. Upon reviewing the session recordings with Dartfish© software, the experimenter discovered that performance had been increasing. Implementing scored observations in the applied setting would be low response effort but may have a higher degree of inaccuracy. The scoring procedures used in this study were time-consuming because of the goal of complete accuracy in scoring participant performance.

Scoring procedures were also complex in this study. Prior to recruiting participants, the safety checklists (see Appendix C, D, E) were approved by a cheer coach. After beginning sessions, experimenters identified that the operational definitions were not clear enough to adequately score behavior. This was most apparent in “base” and “standing tumbling”, which both required a straight back. Dartfish© scoring software allowed experimenters to pause a video and measure various angles. A straight line is 180 degrees, but participants never held their backs at 180 degrees. Researchers needed to meet with the cheer coach an additional time to receive clarification on the correct way to score this behavior.

Another measurement issue identified in this study is the differences in body types. Tracy and Olivia have different body types. The original version of safety target C (see Appendix E) had participants standing with their feet shoulder-width apart prior to jumping into the air. For “standing tumbling”, feet should be relatively close together. In an attempt to make this more measurable, the safety checklist asked participants to stand with their feet shoulder-distance apart. Tracy’s shoulders are broader than her hips, so her stance would have been unsafe if she followed the safety checklist. The safety checklist was changed as soon as this problem was identified, and there were no observed changes in behavior when the checklists were changed. In the applied setting, safe behavior may change based on many factors. One of these is various body types, but safety may also be impacted by height or the skills occurring before or after the target behavior. Future research may need
to individualize safety checklists with the assistance of a coach or other qualified professional.

The present research study shows that scored observations may not be effective for teaching novel cheerleading skills. The participants in this study largely failed to achieve mastery criteria with scored observations alone. When teaching novel behavior, it may be beneficial to slowly introduce the safety checklists. Researchers may choose to ask participants to score portions of the safety checklist that they need to attend to and correct. For example, Olivia did not consistently bend her legs or hold her head in a safe way during baseline performance for “standing tumbling”. It may have been more beneficial to only ask Olivia to score the legs and head portions of the safety checklists.

This research also shows that scored observations may not be effective when teaching or changing complex skills. Both participants in this study failed to consistently hold their backs straight with scored observations alone. While Tracy’s data must be interpreted with caution, Olivia consistently held her back straight and safely following BST sessions for “base” and “standing tumbling”. Conversely, Olivia did not consistently connect her right foot to her left knee during baseline. Shortly after conducting her first scored observation, Olivia began connecting her foot to her leg. This is a simpler change than holding a straight back and may be more suited to changing via scored observations. Future research should evaluate whether the observer effect is affected by the complexity of the skill being performed.

Complex skills cannot be avoided, especially in high levels of athletic performance. Future research should investigate the amount of teaching required for the observer effect to be seen. It is possible that more direct instruction could have made a difference to the participants in this study. Participants may have benefitted from accuracy training or rationale for safe positioning. Results may also change if the participants are experienced cheerleaders who have prior experience with safety training, or even if video models were shown from more than two angles. Future research should identify whether complex skills
can be taught using scored interventions as part of an intervention package. Future research
should also evaluate differences in results between novice and experienced cheerleaders.

Overall, the present research study shows that scored observations may not be sufficient to
increase cheerleader safety. These results may be influenced by many factors (e.g., medical
problems, measurement issues), but they should not be discounted. A majority of existing
sports research in behavior analysis involves packaged interventions (Schenk &
Miltenberger, 2019). Scored observations remain a low-response effort intervention that
may be beneficial in the applied setting. Future research should identify ways to enhance
this intervention to maximize results. These experiments may begin by combining scored
observations with interventions that are also readily available in the applied setting, such as
BST and feedback. Increasing cheerleader safety is an important area that requires further
research to identify relevant factors and effective interventions. Regardless of the lack of
an observer effect in the present study, this research area must continue to be pursued.
References


Figure 1: Percent Correct Across Safety Targets for Olivia
Figure 2: Percent Correct Across Safety Targets for Tracy
Figure 3: Accuracy of Scored Observations for Olivia
Figure 4: Accuracy of Scored Observations for Tracy
Figure 5: Uncalculated Accuracy for Tracy

Uncalculated Accuracy Data

Percent Accurate

Uncalculated Checklist

- Possible Score 1
- Possible Score 2
- Possible Score 3
## Figure 6: Incorrect Safety Targets in Video Models

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<td></td>
<td></td>
</tr>
<tr>
<td>Flyer 1</td>
<td>NA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flyer 2</td>
<td>NA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flyer 3</td>
<td>NA</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Appendix A

PAR-Q Questionnaire

2020 PAR-Q+

The Physical Activity Readiness Questionnaire for Everyone

The health benefits of regular physical activity are clear; more people should engage in physical activity every day of the week. Participating in physical activity is very safe for MOST people. This questionnaire will tell you whether it is necessary for you to seek further advice from your doctor or a qualified exercise professional before becoming more physically active.

GENERAL HEALTH QUESTIONS

Please read the 7 questions below carefully and answer each one honestly: check YES or NO.

1) Has your doctor ever said that you have a heart condition OR high blood pressure?

2) Do you feel pain in your chest at rest, during your daily activities of living, OR when you do physical activity?

3) Do you lose balance because of dizziness OR have you lost consciousness in the last 12 months?

4) Have you ever been diagnosed with another chronic medical condition (other than heart disease or high blood pressure)? Please list condition(s) here:

5) Are you currently taking prescribed medications for a chronic medical condition?

6) Do you currently have (or have had within the past 12 months) a bone, joint, or soft tissue (muscle, ligament, or tendon) problem that could be made worse by becoming more physically active? Please answer NO if you had a problem in the past, but it does not limit your current ability to be physically active. Please list condition(s) here:

7) Has your doctor ever said that you should only do medically supervised physical activity?

If you answered NO to all of the questions above, you are cleared for physical activity. Please sign the PARTICIPANT DECLARATION. You do not need to complete Pages 2 and 3.

Follow Global Physical Activity Guidelines for your age (https://apps.who.int/liga/handic/19665/44199).

You may take part in a health and fitness appraisal.

If you are under the age of 45 and not accustomed to regular vigorous or maximal effort exercise, consult a qualified exercise professional before engaging in this intensity of exercise.

If you have any further questions, contact a qualified exercise professional.

PARTICIPANT DECLARATION

If you are less than the legal age required, consent or require the input of a care provider, your parent, guardian or care provider must also sign this form.

I, the undersigned, have read, understood, and completed this questionnaire. I acknowledge that this physical activity clearance is valid for a maximum of 12 months from the date it is completed and becomes invalid if my condition changes. I also acknowledge that the community/facility center may retain a copy of this form for its records. In these instances, it will maintain the confidentiality of the same, complying with applicable law.

NAME ___________________________ DATE _______________

SIGNATURE ______________________ WITNESS ______________________

SIGNATURE OF PARENT/GUARDIAN/CARE PROVIDER ______________________

If you answered YES to one or more of the questions above, COMPLETE PAGES 2 AND 3.

Delay becoming more active if:

1. You have a temporary illness such as a cold or fever; it is best to wait until you feel better.

2. You are pregnant - talk to your health care practitioner, your physician, a qualified exercise professional, and/or complete the eform at www.examined.org before becoming more physically active.

3. Your health changes - answer the questions on Pages 2 and 3 of this document and/or talk to your doctor or a qualified exercise professional before continuing with any physical activity program.
2020 PAR-Q+  
FOLLOW-UP QUESTIONS ABOUT YOUR MEDICAL CONDITION(S)

1. Do you have Arthritis, Osteoporosis, or Back Problems?  
   If the above condition(s) is/are present, answer questions 1a–1c  
   [Answer NO if you are not currently taking medications or other treatments]
   1a. Do you have difficulty controlling your condition with medications or other physician-prescribed therapies?  
   1b. Have you had steroid injections or taken steroid tablets regularly for more than 3 months?  

2. Do you currently have Cancer of any kind?  
   If the above condition(s) is/are present, answer questions 2a–2b  
   2a. Does your cancer diagnosis include any of the following types: lung/breast/ovarian, multiple myeloma (cancer of plasma cells), head, and/or neck?  
   2b. Are you currently receiving cancer therapy (such as chemotherapy or radiation therapy)?

3. Do you have a Heart or Cardiovascular Condition? This includes Coronary Artery Disease, Heart Failure, Diagnosed Abnormality of Heart Rhythm  
   If the above condition(s) is/are present, answer questions 3a–3d  
   3a. Do you have difficulty controlling your condition with medications or other physician-prescribed therapies?  
   3b. Do you have an irregular heartbeat that requires medical management?  
   3c. Do you have chronic heart failure?  
   3d. Do you have a history of heart disease and have not participated in regular physical activity in the last 2 months?

4. Do you currently have High Blood Pressure?  
   If the above condition(s) is/are present, answer questions 4a–4b  
   4a. Do you have difficulty controlling your condition with medications or other physician-prescribed therapies?  
   4b. Do you have a resting blood pressure equal to or greater than 160/90 mmHg or without medication?

5. Do you have any Metabolic Conditions? This includes Type 1 Diabetes, Type 2 Diabetes, Pre Diabetes  
   If the above condition(s) is/are present, answer questions 5a–5e  
   5a. Do you often have difficulty controlling your blood sugar levels with meals, medications, or other physician-prescribed therapies?  
   5b. Do you often suffer from signs and symptoms of low blood sugar (hypoglycemia) following exercise and/or during activities of daily living?  
   5c. Do you have any signs or symptoms of diabetes complications such as heart or vascular disease and/or complications affecting your eyes, kidneys, OR the sensation in your lips and feet?  
   5d. Are you planning to engage in a sport for which you are unusually high (or vigorous) intensity exercise in the near future?
6. Do you have any Mental Health Problems or Learning Difficulties? This includes: Alzheimer’s, Dementia, Depression, Anxiety Disorder, Eating Disorder, Psychotic Disorder, Intellectual Disability, Down Syndrome
   If the above condition(s) is/are present, answer questions 5a-5b
   (Answer NO if you are not currently taking medications or other treatments)
   5a. Do you have difficulty controlling your condition with medications or other physician-prescribed therapies?
      YES ☐ NO ☐
   5b. Do you have Down Syndrome AND back problems affecting nerves or muscles?
      YES ☐ NO ☐

7. Do you have a Respiratory Disease? This includes: Chronic Obstructive Pulmonary Disease, Asthma, Pulmonary, High Blood Pressure
   If the above condition(s) is/are present, answer questions 7a-7d
   (Answer NO if you are not currently taking medications or other treatments)
   7a. Do you have difficulty controlling your condition with medications or other physician-prescribed therapies?
      YES ☐ NO ☐
   7b. Has your doctor ever said your blood oxygen level is low at rest or during exercise and/or that you require supplemental oxygen therapy?
      YES ☐ NO ☐
   7c. If asthmatic, do you currently have symptoms of chest tightness, wheezing, laboured breathing, consistent cough (more than 3 days/week), or have you used your rescue medication more than twice in the last week?
      YES ☐ NO ☐
   7d. Has your doctor ever said you have high blood pressure in the blood vessels of your lungs?
      YES ☐ NO ☐

8. Do you have a Spinal Cord Injury? This includes Tetraplegia and Paraplegia
   If the above condition(s) is/are present, answer questions 8a-8c
   (Answer NO if you are not currently taking medications or other treatments)
   8a. Do you have difficulty controlling your condition with medications or other physician-prescribed therapies?
      YES ☐ NO ☐
   8b. Do you commonly exhibit low resting blood pressure significant enough to cause dizziness, light-headedness, and/or fainting?
      YES ☐ NO ☐
   8c. Has your physician indicated that you exhibit sudden bouts of high blood pressure (known as Autonomic Dysreflexia)?
      YES ☐ NO ☐

9. Have you had a Stroke? This includes: Transient Ischemic Attack (TIA) or Cerebrovascular Event
   If the above condition(s) is/are present, answer questions 9a-9d
   (Answer NO if you are not currently taking medications or other treatments)
   9a. Do you have difficulty controlling your condition with medications or other physician-prescribed therapies?
      YES ☐ NO ☐
   9b. Do you have any impairment in walking or mobility?
      YES ☐ NO ☐
   9c. Have you experienced a stroke or impairment in nerves or muscles in the past 5 months?
      YES ☐ NO ☐

10. Do you have any other medical condition not listed above or do you have two or more medical conditions?
    If you have other medical conditions, answer questions 10a-10c
    (Answer NO if you are not currently taking medications or other treatments)
    10a. Have you experienced a blackout, fainted, or lost consciousness as a result of a head injury within the last 12 months OR have you had a diagnosed concussion within the last 12 months?
         YES ☐ NO ☐
    10b. Do you have a medical condition that is not listed (such as epilepsy, neurological conditions, kidney problems)?
         YES ☐ NO ☐
    10c. Do you currently live with two or more medical conditions?
         YES ☐ NO ☐

PLEASE LIST YOUR MEDICAL CONDITIONS AND ANY RELATED MEDICATIONS HERE.

GO to Page 4 for recommendations about your current medical condition(s) and sign the PARTICIPANT DECLARATION.
2020 PAR-Q+

If you answered NO to all of the FOLLOW-UP questions (pgs. 2-3) about your medical condition, you are ready to become more physically active - sign the PARTICIPANT DECLARATION below:

- It is advised that you consult a qualified exercise professional to help you develop a safe and effective physical activity plan to meet your health needs.
- You are encouraged to start slowly and build up gradually: 20 to 60 minutes of low to moderate intensity exercise, 3-5 days per week including aerobic and muscle strengthening exercises.
- As you progress, you should aim to accumulate 150 minutes or more of moderate intensity physical activity per week.
- If you are over the age of 45 yr and NOT accustomed to regular vigorous to maximal effort exercise, consult a qualified exercise professional before engaging in this intensity of exercise.

If you answered YES to one or more of the follow-up questions about your medical condition:
You should seek further information before becoming more physically active or engaging in a fitness appraisal. You should complete the specially designed online screening and exercise recommenders program - the ePARmed-K+ at www.eparmed.com and/or visit a qualified exercise professional to work through the ePARmed-K+ and for further information.

Delay becoming more active if:
- You have a temporary illness such as a cold or fever; it is best to wait until you feel better.
- You are pregnant - talk to your healthcare practitioner, your physician, a qualified exercise professional, and/or complete the ePARmed-K+ at www.eparmed.com before becoming more physically active.
- Your health changes - talk to your doctor or qualified exercise professional before continuing with any physical activity program.

- You are encouraged to photocopy the PAR-Q+. You must use the entire questionnaire and NO changes are permitted.
- The author, the PAR-Q+ Collaboration, partner organizations, and their agents assume no liability for persons who undertake physical activity and/or make use of the PAR-Q+ or ePARmed-K+. It is in doubt after completing the questionnaire, consult your doctor prior to physical activity.

PARTICIPANT DECLARATION

- All persons who have completed the PAR-Q+ please read and sign the declaration below.
- If you are less than the legal age required for consent or require the assent of a care provider, your parent, guardian or care provider must also sign this form.

I, the undersigned, have read, understood to my full satisfaction and completed this questionnaire. I acknowledge that this physical activity clearance is valid for a maximum of 12 months from the date it is completed and becomes invalid if my condition changes. I also acknowledge that the community/fitness centre may retain a copy of this form for records. In these instances, it will maintain the confidentiality of the same, complying with applicable law.

NAME ___________________________ DATE ____________

SIGNATURE ________________________ WITNESS ________________________

SIGNATURE OF PARENT/GUARDIAN/CARE PROVIDER ________________________

For more information, please contact
www.eparmed.com
email: eparmed@gmail.com

The PAR-Q+ was created using the evidence-based AGREE2 generator (1) by the PAR-Q+ Collaboration chaired by Dr. Bruce C. & W. Wearth, Toronto, ON, Canada.

Collaborators include Dr. Norman G. de Souza, Dr. Antonio J. G. Barreto, and Dr. Donald C. McMorris. Publication of this document has been made possible through financial contributions from the Public Health Agency of Canada and the BC Ministry of Health Services. The views expressed herein do not necessarily represent the views of the Public Health Agency of Canada or the BC Ministry of Health Services.

Key References

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13-03-2019
Appendix B

Informed Consent Document

Please read this consent document carefully before you decide to participate in this project. The researcher will answer any questions before you sign this form.

**Project Title:** Improving Cheerleading Performance

**Purpose of the Project:** You are being invited to participate in a study that is intended to examine the execution of cheerleading safety behaviors as learned through a video modeling procedure.

**Procedures:** During this study you will learn to perform various basic cheerleading movements and choreography. The total duration of time anticipated for these sessions is estimated to be approximately 3 hours total.

**Potential Risks of Participating:** This study may result in increased health risks, due to lifting no more than 8 pounds. You may become physically fatigued, fall, or be seen by staff or peers at the research site. As such, you are required to complete the PAR-Q Questionnaire prior to participation. During research sessions, the researcher will stand within 3 feet of you to catch you if you fall. Signs will be placed on doors when research sessions are being conducted to protect participant identity. Overall, there are minimal risks compared to those seen in everyday life.

**Potential Benefits of Participating:** The results of the study could benefit athletes in general and cheerleaders in particular, as sports injuries are a dangerous problem facing athletes. Little behavior analytic research has been conducted on procedures to improve the safety of athletes, and little research has been conducted on cheerleading. This research could lead to procedures being implemented within sports teams to increase their safety.
You will also be offered a data-based decision-making training, which may count towards practicum-required hours, at the conclusion of the study. You may see an increase in your research skills and identify whether you are able to learn from collecting data on video models.

**Compensation:** You may receive a research training following completion of this study. Some participants may also volunteer to participate. If you opt to receive the research training, the time spent in this training may count towards your required practicum hours at your CSF supervisor’s discretion.

**Confidentiality and Audio/ Video Recordings:** All sessions will be video recorded via two video cameras in the intervention room. These recordings will be required to review the sessions for treatment integrity and inter-observer agreement (IOA) purposes. The recordings will only be used for research purposes and will be deleted once data has been obtained from them.

Your data may be presented at a conference or published in a journal. However, data sheets and posted graphs will be coded to ensure anonymity. No participant data will be shared with non-experimenters, excluding dissemination of findings. Pseudo names will be assigned to each participant to ensure no data can be associated with a particular participant. All data will be stored in an electronic file (e.g., password protected, secure network) under the control of the primary investigator. All recordings will be stored on password protected devices and will only be accessible to the researchers identified as being part of the study.

**Voluntary participation:** Your participation in this study is voluntary. You may choose not to participate without penalty. You may also refuse to answer any of the questions you are asked.

**Right to Withdraw from the Study:** You have the right to withdraw from the study at any time without consequence. Sessions will begin by asking whether you feel physically
capable of completing the session. You will be reminded that you can stop at any point you begin to feel fatigued.

**Whom to Contact if you have Questions About the Study:**

Primary Investigator

Maddie Duke

mduke2021@my.fit.edu

Dr. Jonathan Fernand

Faculty Advisor

jfernand@fit.edu

Dr. David Wilder

Head of School of Behavior Analysis

dawilder@fit.edu

Whom to Contact About Your Rights as a Research Participant in the Study:

Dr. Jignya Patel, IRB Chairperson

FIT_IRB@fit.edu

321-674-7391
Agreement: I have read the procedure described above. I have completed the PAR-Q Questionnaire. The questionnaire recommended my participation in this study or I have received a physician’s approval for participation.

I voluntarily agree to participate in the procedure and allow my data to be used for research purposes as described above, and I have received a copy of this description.

Participant: _________________________________________ Date: ________________

Principal Investigator: _________________________________ Date: ________________
Appendix C

Safety Checklist

<table>
<thead>
<tr>
<th>Safety Target A1: Base</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1: Hand Position</td>
<td>All ten fingers should be gripping the hexagon part of the dumbbell. The thumbs should be on the flat, outer portion of the dumbbell, and the other eight fingers should be close together on the front. Palms are under the hexagon part of the dumbbell.</td>
</tr>
<tr>
<td>2: Elbow Position</td>
<td>Elbows are bent at 90 degrees.</td>
</tr>
<tr>
<td>3: Back Position</td>
<td>Back is straight with shoulders positioned over the hips.</td>
</tr>
<tr>
<td>4: Leg Position</td>
<td>Legs are bent between 80-110 degrees with knees above the toes.</td>
</tr>
<tr>
<td>5: Feet Position</td>
<td>Feet should be planted on the ground about hip distance apart.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Safety Target A2: Base</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>6: Shoulder Position</td>
<td>Shoulders are engaged and stacked on top of the hips.</td>
</tr>
<tr>
<td>7: Arm Position</td>
<td>Arms are straight and near the temples.</td>
</tr>
<tr>
<td>8: Hand Position</td>
<td>All ten fingers should be gripping the dumbbell. Palms should be flat under the hexagon portion of the dumbbell. Thumbs should now be on the back portion of the dumbbell with the other 8 fingers on the flat, outer portion of the dumbbell.</td>
</tr>
<tr>
<td>9: Back Position</td>
<td>Back continues to be straight from the shoulders to the hips.</td>
</tr>
<tr>
<td>10: Leg Position</td>
<td>Legs should be straight and parallel to the walls.</td>
</tr>
</tbody>
</table>

Initials: ___________________________    Date: ________________
Appendix D

Safety Checklist

<table>
<thead>
<tr>
<th>Safety Target B1: Standing Tumbling</th>
<th>X</th>
</tr>
</thead>
<tbody>
<tr>
<td>1: Head/ Neck Position</td>
<td>Head is in line with the neck or looking slightly upwards.</td>
</tr>
<tr>
<td>2: Arm Position</td>
<td>Arms are straight and close to the body, pointing slightly back.</td>
</tr>
<tr>
<td>3: Back Position</td>
<td>Back should be straight with shoulders over the thighs.</td>
</tr>
<tr>
<td>4: Leg Position</td>
<td>Legs are bent between 80-110 degrees with knees above the toes.</td>
</tr>
<tr>
<td>5: Feet Position</td>
<td>Feet are flat on the ground &amp; about hip-width apart.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Safety Target B2: Standing Tumbling</th>
<th>X</th>
</tr>
</thead>
<tbody>
<tr>
<td>6: Head/ Neck Position</td>
<td>Head is in line with the neck and looking straight forward.</td>
</tr>
<tr>
<td>7: Arm Position</td>
<td>Arms should be straight above the head.</td>
</tr>
<tr>
<td>8: Back Position</td>
<td>Back is straight with the shoulders on top of the hips.</td>
</tr>
<tr>
<td>9: Leg Position</td>
<td>Legs should be straight and close together.</td>
</tr>
<tr>
<td>10: Feet Position</td>
<td>Feet should be no more than shoulder-width apart and off the ground.</td>
</tr>
</tbody>
</table>

Initials: ___________________ Date: ________________


## Appendix E

### Safety Checklist

<table>
<thead>
<tr>
<th>Safety Target C1: Flyer</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1: Head/ Neck Position</td>
<td>Head should be in line with the neck with the chin parallel to the ground.</td>
</tr>
<tr>
<td>2: Arm Position</td>
<td>Arms are straight and close to the sides of the body.</td>
</tr>
<tr>
<td>3: Left Leg Position</td>
<td>Left leg should be straight and parallel to the walls.</td>
</tr>
<tr>
<td>4: Right Leg Position</td>
<td>Right leg should be slightly bent with the foot hovering above the floor.</td>
</tr>
<tr>
<td>5: Hip Position</td>
<td>Hips should be facing forward with the right hip higher than the left hip.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Safety Target C2: Flyer</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>6: Arm Position</td>
<td>Arms should be above the head and about 45 degrees from ears.</td>
</tr>
<tr>
<td>7: Left Leg Position</td>
<td>Left leg should be straight and parallel to the walls.</td>
</tr>
<tr>
<td>8: Right Leg Position</td>
<td>Right leg should be bent with the right knee facing straight forward.</td>
</tr>
<tr>
<td>9: Right Foot Position</td>
<td>Right foot should be connected to the left knee. The middle of the right foot should be touching the middle of the left knee.</td>
</tr>
<tr>
<td>10: Hip Position</td>
<td>Hips should be facing forward with the right hip higher than the left hip.</td>
</tr>
</tbody>
</table>

Initials: ___________________ Date: ___________________
# Appendix F

## Procedural Integrity Checklist

<table>
<thead>
<tr>
<th>Description</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Researcher gave the participant the correct safety checklist (matched the video model)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Participant attended to the video model for the full length of the video the first time they viewed the video model</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Participant filled out the safety checklist during or directly after viewing the video model a second time (if applicable)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Participant viewed the video model no more than two times per session</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Participant filled out each portion of the safety checklist (if applicable)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Researcher thanked the participant for filling out the safety checklist without giving other feedback or praise (if applicable)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Researcher instructed the participant to follow the same set of movements they observed in the video model</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Researcher thanked the participant for imitating the video model without giving other feedback or praise</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Appendix G

Social Validity Survey

Please review and respond to the following statements, with a rating ranging from 1-5, with 1 being ‘strongly disagree’, and 5 being ‘strongly agree’. Underline or highlight the rating which most accurately aligns with your agreement or disagreement with the statements presented.

<table>
<thead>
<tr>
<th>Question</th>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>I felt comfortable filling out the safety checklists.</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>The safety checklists were easy to fill out.</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>I was able to simultaneously attend to the video model and fill out the safety checklist.</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>Collecting data on video models helped me become more aware of my own behavior.</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>Collecting data on video models increased my confidence in the behaviors on the safety checklist.</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>The video models were easy to imitate.</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>I would collect data on video models to help improve future performance in athletics.</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>I would collect data on video models to help improve future performance in tasks other than athletics.</td>
<td>1 2 3 4 5</td>
</tr>
<tr>
<td>I would recommend this intervention to a friend.</td>
<td>1 2 3 4 5</td>
</tr>
</tbody>
</table>