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Evaluating TAGteach as a Training Procedure for Novice-to-Advanced Fastpitch Softball Pitchers

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Abstract

Among the many behavioral coaching techniques available, acoustical guidance has been found to be highly effective in enhancing the athletic skills involved in a variety of sports (e.g. football, golf, dance, yoga, judo). TAGteach is a procedure in which a clicker is used to deliver immediate acoustical guidance to train a new skill or enhance a skill already in the subject's repertoire (TAGteach International, 2012). The current study was conducted to evaluate the effectiveness of TAGteach in developing and/or enhancing the pitching skills of novice-to-advanced fastpitch softball pitchers. Results demonstrated an improvement in accuracy across skill sets for each subject's selected pitch. Improved performance also generalized from the training setting to the game setting.

Introduction

The Centers for Disease Control and Prevention (2016) suggest there are many benefits for both children and adults engaging in physical activity for at least 60 minutes each day, including potentially longer life expectancy, improved weight control, and lowered risk for heart disease, stroke, Type 2 diabetes, depression, and some cancers. A common way for individuals of all ages, backgrounds, motor capabilities, and educational levels to participate in physical activity is through sports. Whether it be individual or team, beginner or professional, indoor or outdoor, many individuals are involved in some sport at some time in their lives.

There might be multiple variables responsible for individuals continuing to play a sport (such as the health benefits mentioned above) or not continuing to play a sport (such as the necessary investment of time and money). One factor that might increase or decrease an athlete's motivation to play a sport is the coaching strategies implemented. Coaching typically is limited to individual approaches that consist of nonsystematic applications of strategies such as verbal instruction, feedback, modeling, and prompting (Shapiro & Shapiro, 1985). For example, feedback from game performance might not be given until practice the next day, prompts might not be specific to an athlete's skill level, or verbal instructions might be given only in regards to poor performance and then mostly in the form of reprimands rather than praise. Shapiro and Shapiro also suggested standard coaching tends to focus more on the global aspects of skill execution instead of the specification or training of component skills. This combination of nonsystematic, delayed, and nonspecific coaching styles might hinder skill acquisition and eventually lead the individual to seek out a different, more reinforcing activity.

One branch of science particularly effective at changing the behavior of individuals is operant learning, foundations of which can be attributed to the work of B.F. Skinner (Skinner,

1938). A basic assumption of operant conditioning is that most behavior is controlled by consequences in its surrounding environment. As discussed by Martin and Hrycaiko (1983), behavioral principles might be used to develop: (a) strategies for analyzing behavior into small components, (b) instructional techniques for developing component behaviors, and (c) reinforcement strategies for strengthening and maintaining desirable performances. In the field of applied behavior analysis (ABA), researchers and practitioners commonly use these core concepts to decrease problem behavior and increase appropriate responses in individuals with intellectual disabilities. Techniques such as reinforcement, punishment, prompting, and shaping (to name a few) are supported by an extensive amount of research to effectively change a variety of behavior across many different settings and individuals. One possible reason for the lack of a systematic approach to coaching might be the scarcity of evidence-based research on specific coaching procedures. Behavioral coaching was created to help solve this problem in the 1970s (Komaki & Barnett, 1977; McKenzie & Rushall, 1974; Rushall & Siedentop, 1972).

Based on foundations of operant learning, behavioral coaching is an instructional approach used in the sport setting. As an alternative to the nonsystematic and seemingly random standard coaching techniques, behavioral coaching uses objective measures and specific teaching strategies to enhance and/or develop athletic skills. A few of the techniques used frequently in behavioral coaching include modeling, goal posting, and feedback. TAGteach is a specific teaching strategy that provides immediate feedback of correct performances via a tagger and was the technique used in the current study. While the amount of empirical research to support the effectiveness of behavioral coaching has expanded since its development in the 1970s, there are still many areas yet to be explored.

Review of Literature

Behavioral Coaching

In defining behavioral coaching, Seniuk, Witts, Williams, and Ghezzi (2013) described coaching as the act of training an individual to play a sport, do a job better, or improve a skill; they then defined behavioral coaching as a behavioral approach to accomplishing the goals of coaching. Similarly, Martin and Hrycaiko (1983) suggested effective behavioral coaching might be referred to as the consistent employment of behavioral principles to improve and maintain athletic behavior. In a review of single subject-design interventions for enhancing sport performance over the past 30 years, Martin, Thompson, and Regehr (2004) identified 40 studies that met their inclusion criteria. Maintaining behavioral dimensions described by Baer, Wolf, and Risley (1968), inclusion criteria for the review were as follows: (1) participants had to be athletes who competed on a regular and organized basis; (2) dependent variables had to be a direct measure of athletic performance during actual practices or competitions that were considered to be typical for athletes in the sport studied; (3) acceptable interobserver reliability data on the dependent measures, or game statistics data on objective measures, were included; and (4) graphs of the performance of individual subjects across baseline and treatment sessions and a single-subject research design were used. Of the 16 different sports included, basketball was the best represented sport with nine studies, swimming came in second with six, and football, tennis, and track/triathlon were examined in four studies each. Common intervention characteristics included goal setting, self-talk, imagery, verbal instructions, the freeze technique (participants remained still during a specific movement and were given feedback on their body position), modeling, feedback, or some behavioral package of multiple treatments. Although most interventions were determined to be responsible for changes in the dependent variables (in all but

four studies), only six studies assessed generalizability of performance from practice to competition. Similarly, only four studies included a follow-up phase to assess maintenance of skill improvement.

Martin and Hrycaiko (1983) identified six defining characteristics of behavioral coaching, which they noted draw heavily on the techniques and concepts of ABA as described by Baer, Wolf, and Risley (1968). The six characteristics of behavioral coaching are as follows: 1) the specific and detailed measurement of athletic performance; 2) a distinction between developing new behavior and maintaining existing behavior; 3) encouragement to improve against the performance of oneself and others; 4) an emphasis on coaching as a science, not an art; 5) behavior modification for the coach; and 6) social validation.

1. Measurement of athletic performance. One key component to any behavior-change strategy is an emphasis on specific, detailed, and frequent measurement of the behavior of interest. Whether the behavior is tantruming, doing math problems, or kicking a soccer ball, adequate measurements must be taken to evaluate the effectiveness of an intervention. One way to ensure thorough data collection is to create a list that defines the specific components, or behavioral categories, of concern. For example, Allison and Ayllon (1980) evaluated behavioral coaching as a strategy to develop skills in football, gymnastics, and tennis. For all three sports, the authors operationally defined which behavioral skills they were targeting, the elements necessary to perform that skill correctly, and the number of trials conducted (per component) before adequate observation was achieved. In addition to the sport-specific dimensions that were measured to evaluate the athlete's performance, a detailed outline was created for the behavioral coaching strategies used. The specific step-by-step behavioral coaching method used by Allison and Ayllon was not only applicable for all three sports in their study, but has also been applied to

coaching track (Shapiro & Shapiro, 1985) and ballet (Fitterling & Ayllon, 1983). In preparing an objective outline for athletic performance and/or coaching strategy, researchers can more adequately monitor and assess data collected and, therefore, have a better chance of ensuring their evaluation of results is both reliable and valid.

      2. Distinction between developing and maintaining behavior. Another important characteristic of behavioral coaching is that it has the functional capabilities of developing an entirely new skill or working to maintain a skill already in the athlete's repertoire. Procedures that can both develop and maintain athletic performance have had a great deal of research supporting their effectiveness. As suggested by Martin and Hrycaiko (1983), the development of new skills might be achieved via techniques such as instruction, demonstration, role-playing, physical guidance, shaping, immediate rewards for progress, and corrective instruction for errors. In one example, Kladopoulos and McComas (2001) used instruction and feedback (descriptive praise) to train proper foul-shooting form by three women's college basketball players. Similarly, Stokes and Luiselli (2010) looked at the effect of delayed written feedback on the tackling skills of a high school football athlete. In this experiment, unlike most behavioral coaching research, a functional analysis was conducted to determine which condition (no attention, coach attention, peer attention, or escape) was associated with optimal performance. The authors found that the highest percentage of correct tackling occurred when the athlete was able to "escape" interaction with the coach following drills. While these two studies focused ultimately on skill development, they also provide evidence that supports behavioral coaching as an effective way to maintain athletic performance.

      For example, Koop and Martin (1983) demonstrated a combination of coaching strategies reduced swimming stroke errors in inexperienced swimmers. Some coaching components used to

develop appropriate swimming skills included modeling, verbal and visual prompts, role-play for initial training, immediate instructional feedback for incorrect performances, and praise for correct performances. In addition, this study included a follow-up phase where swimmer performance and coaching behavior were evaluated after prompts and feedback were faded to ensure the skills developed would maintain after training ended. In another study, Stokes, Luiselli, and Reed (2010) demonstrated the effectiveness of behavioral coaching for developing and maintaining tackling in two high school football athletes. They used a multicomponent behavioral intervention during practice to increase percentage of tackling steps executed correctly. This intervention included withholding negative comments for incorrect performance and providing positive reinforcement in the form of helmet stickers and praise for an individual matching or exceeding his own prior correct tackling percentage. Tackling proficiency also was assessed during games after training ended to evaluate skill maintenance. The authors found the intervention effectively increased tackling proficiency during practice drills and skills maintained during games.

       3. Encouragement to improve against performance. A third component to effective behavioral coaching, and possibly the one most recognized and empirically supported, is that the athletes monitor and compete against their own previous performance. This concept is commonly seen in goal setting, public posting of individual performance, and video feedback of oneself. Interestingly enough, the first study published to use ABA principles in a sport setting evaluated the effects of self-recording on swimmer's attendance and performance at practice (McKenzie & Rushall, 1974). Subjects first were required to keep track of their attendance on a public board, which eventually resulted in a reduction of absentees, late arrivals, and early departures. Subjects then were required to publicly self-record training units completed, which

also was effective for increasing work output during practice. In a different way, Swain and Jones (1995) looked at goal setting as an intervention to encourage improvement against each athlete's own prior performance. In their experiment, the authors demonstrated that goal setting was an effective behavioral coaching strategy to increase in-game performance for select basketball skill components exhibited by three out of four male collegiate athletes. Public posting and goal setting have commonly been combined as a behavioral coaching package. For example, the soccer skills of high school female athletes (Brobst & Ward, 2002) and the football skills of collegiate male athletes (Ward & Carnes, 2002) were found to increase as a result of publicly posted attainment of coach-determined and player-determined goals, respectively.

As mentioned previously, such interventions also might include the use of video recordings to evaluate and monitor execution of athletic skills. To enhance the gymnastic skills of four female gymnasts, Boyer, Miltenberger, Batsche, and Fogel (2009) examined video modeling by experts combined with video feedback of the athlete's own performance as a behavioral coaching strategy. By combining the two techniques, video modeling and feedback, the authors provided a great example of a coaching strategy that encourages improvement against one's own performance as well as the performance of others.

4. Emphasis on coaching as a science. One of the reasons ABA has been found to be effective at changing behavior, whether athletic or non-athletic, is because its procedures are evidence-based. That is, when emphasis is placed on principles of behavior that are specific, objective, and replicable, the interventions and observed outcomes then can be evaluated against other evidence-based procedures. Thus, if behavioral coaching follows the foundations and guidelines found in ABA, it might also achieve the same scientific and evidence-based reputation. According to Martin and Hrycaiko (1983), effective behavioral coaching assumes a

commitment to the consistent application of procedures that are objective, systematic, and supported by data. Behavioral coaching also requires frequent and reliable measurement of the behavior of interest. An adequate measurement system is possibly the most important characteristic of behavioral coaching because without it there is no way to objectively monitor progress and evaluate results.

Another significant aspect of any behavior-change procedure is the inclusion of three phases: baseline, treatment, and follow-up. Experiments or applications in the natural environment that include these three phases allow for a more thorough and scientific demonstration of any changes that might have occurred. To achieve minimal scientific standards, it is unlikely for experimental research to be conducted without baseline and treatment data. Ultimately, without baseline and treatment measurements it is impossible to reliably demonstrate any significant results of the study. Unlike baseline and treatment data, though, follow-up measurements are not conducted in every study. Although research that exempts the collection of follow-up data can still demonstrate change from baseline to treatment, it cannot show whether or not that change in behavior was maintained after the intervention has been withdrawn and/or has generalized to a different setting. Follow-up data are not always included in behavior-change research studies in general, and experiments involving behavioral coaching techniques are no exception. For example, in their review of research on enhancing athletic performance in the past 30 years, Martin et al. (2004) only came across four out of 40 studies that included a formal follow-up phase (Brobst & Ward, 2002; Hazen, Johnstone, Martin, & Srikameswaran, 1990; Koop & Martin, 1983; Rushall & Smith, 1979).

Another component that factors into a treatment's effectiveness is the generalization of treatment effects to a new environment. Similar to the ability of a skill to maintain over time, a

skill's generalizability to a setting other than the one in which it was trained should be included in research studies. In their review, Martin et al. (2004) found six studies (out of 40) probed for stimulus generalization from the training environment to games or competition (Brobst & Ward, 2002; Komaki & Barnett, 1977; Landin & Hebert, 1999; Wanlin, Hrycaiko, Martin, & Mahon, 1997; Ward & Carnes, 2002; Ward, Smith, & Sharp, 1997). Since the review, there are still very few studies that have included follow-up phases to assess maintenance (e.g., Boyer et al., 2009) and probes to assess generalization (e.g., Stokes & Luiselli, 2010; Stokes, Luiselli, & Reed, 2010; Stokes, Luiselli, Reed, & Fleming, 2010).

5. Behavior modification for the coach. The fifth component of effective behavioral coaching focuses on the behavior of the coach. In the first few components, behavioral coaching was described only as it relates to changing the performance of the athlete. Research has demonstrated the same principles can be applied to alter the coach's behavior as well. For example, Rushall and Smith (1979) used video-feedback and self-recording techniques to increase the verbal repertoire and rates of reinforcement and feedback of an adult swimming coach. Similarly, Smith, Smoll, and Curtis (1979) enhanced the effectiveness of Little League® baseball coaches by using modeling, feedback, and self-monitoring techniques. Additionally, Smith, Smoll, and Hunt (1977) developed The Coaching Behavior Assessment System (CBAS) as a means for coding and analyzing the behavior of athletic coaches in naturalistic settings. After conducting content analyses of coaching behaviors during practices and games, the authors proposed 12 behavioral categories (e.g., reinforcement, failure to provide reinforcement, corrective instruction for mistakes, punishment, ignoring mistakes) that might enhance training programs for coaches. Several studies were conducted to assess the reliability of the CBAS as a coding system. Results indicated the CBAS can be used by observers with a high degree of

reliability and accuracy, and it has the potential to enhance coaching behaviors across multiple sports and skill sets.

      6. Social validation. The final characteristic of effective behavioral coaching, as suggested by Martin and Hrycaiko (1983), concerns the social validity of the coaching strategy being used. When determining the social validity of a coaching program or any behavior change program, the goals, procedures, and results should be evaluated. To obtain an unbiased and thorough assessment, coaches are encouraged to have athletes, parents, and others involved in the sport environment evaluate all aspects of the coaching program. While results of a study might determine if an intervention was responsible for change in behavior, measurements of social validity provide support for the practicality and acceptance of the intervention by those directly affected by it.

      Out of the 40 studies Martin et al. (2004) included in their review of interventions designed to enhance performance of athletes and coaching, 26 included a formal social validity evaluation conducted with subjects. The most common, and seemingly most practical, way to assess social validity is through a questionnaire and/or interview. To demonstrate, Boyer et al. (2009) provided a questionnaire to gymnasts, coaches, and assistant coaches in which they could rate their preference for the procedure, whether they would recommend it to others, how easy and helpful it was, and how effective it was in skill development. The authors included an additional measure of social validity by having three professional judges score two baseline and two intervention clips for each skill to determine whether improvements were significant enough to be seen at professional standards. In the literature, the social validity of behavioral coaching procedures has been evaluated in the same questionnaire format across many different sports and

interventions (e.g., Allison & Ayllon, 1980; Brobst & Ward, 2002; Koop & Martin, 1983; Shapiro & Shapiro, 1985; Swain & Jones, 1995).

Acoustical Guidance and TAGteach

One behavioral coaching technique yet to be extensively researched is the use of acoustical guidance. Acoustical guidance is similar to verbal feedback in that a given response is followed by an informative consequence. For example, after a volleyball player correctly performs an overhand serve the coach might say, "Great job; excellent follow-through." Alternatively, if the athlete performed the skill incorrectly, the coach might say, "That was wrong; you could do better." The difference with acoustical guidance is that verbal feedback is replaced with a simple "click" or "beep." To illustrate, a skill performed correctly would immediately receive a "click" whereas a skill performed incorrectly would have no consequence. Just like the different behavioral coaching strategies mentioned above, acoustical guidance can be used as part of a coaching package or alone to teach new skills or shape up skills already in the athlete's repertoire. Although not yet fully demonstrated in the literature, acoustical guidance has the potential to be an effective behavioral coaching technique and satisfies all six characteristics suggested by Martin and Hrycaiko (1983).

One study that demonstrated how acoustical guidance might be used to teach a new complex skill was by Levy, Pryor, and McKeon (2016). While teaching two surgical skills, tying a knot and making a drill hole, the researchers compared two teaching strategies, acoustical guidance and demonstration. Based on the results of the experiment, the group who received teaching with acoustical guidance performed the two skills with greater precision and accuracy than the group who was only taught via demonstration. Although this study was not sport-related, it did show how individuals might benefit more from a teaching strategy that uses

acoustical guidance rather than demonstration, or modeling, when learning a complex skill. The

first study to use acoustical guidance in the sport setting was conducted by Scott, Scott, and

Goldwater (1997), in which they improved the technical skill and overall performance of an

internationally-competitive pole vaulter. The intervention used a photoelectric beam, along with

prompting and shaping, to increase the athlete's arm extension at takeoff. Feedback in the form

of a "beep" was provided only when the athlete's hand broke the photoelectric beam. The height

requirement gradually increased until the athlete could consistently achieve his goal arm

extension. The authors concluded the intervention increased the athlete's reach at takeoff, which

in turn had a positive effect on the maximum height cleared while vaulting.

To make acoustical guidance a more technical and systematic teaching strategy, an

approach named TAGteach (Teaching with Auditory Guidance) was created. Based on the

science of behavior, TAGteach was founded in the early 2000s and uses positive reinforcement,

a main principle of operant conditioning, to shape correct components of a complex skill

(TAGteach International, 2012). A tag point (the targeted skill component) is clearly defined by

the teacher of the skill so the learner knows exactly what needs to be done to achieve success.

For example, hand washing (the skill) would be broken down into separate skill components

(turn on water, get soap, etc.), each of which would then be identified as a tag point. When the

skill is performed correctly, the tagger (usually a clicker held by the teacher) provides immediate

feedback. This makes TAGteach unlike other interventions in which reinforcement generally is

delayed until after the complete behavioral sequence is performed. To further explain, if a

student is learning to wash his hands and the tag point is "wash backside of left hand for five

seconds", he would hear a click immediately after he washed the backside of his left hand for

five seconds, rather than waiting for the teacher to tell him whether or not they performed that

step correctly after he had completed the entire hand washing routine. TAGteach also differs from other feedback methods in that it is only delivered following successful performances, as opposed to error correction, and it decreases the need for verbal feedback and primary conditioners, such as food in clicker training with animals. Additionally, TAGteach might be more preferred than other interventions because it is easily implemented by teachers, easily understood by learners, and creates a positive learning environment for both teacher and learner (TAGteach International, 2012).

TAGteach within a treatment package. As demonstrated thus far, behavioral coaching is not always a straightforward methodology. There are many variables to consider when implementing an intervention and, from there, many intervention strategies from which to choose. One of the main components highlighted in research on TAGteach specifically is whether it is used as part of a behavioral package or as a stand-alone treatment. In the first study to evaluate TAGteach as part of a behavioral coaching package, Stokes, Luiselli, Reed, and Fleming (2010) improved blocking skills of five high school varsity football players. Implemented by a coach during practice drills, the intervention included descriptive feedback, with and without video feedback, and TAGteach. Results indicated all subjects met the criterion for blocking during the descriptive and video feedback phase, but the TAGteach component allowed them to exceed (three out of four subjects) or consistently stay within the criterion (one out of four subjects). Skill levels achieved during practice generalized to game performance, and all subjects reported they preferred the behavioral coaching treatment to a standard coaching procedure.

In a similar study, Harrison and Pyles (2013) evaluated TAGteach paired with verbal instruction and shaping to improve tackling skills of three high school football athletes. All

tackling was trained using a football "dummy" or cone as opposed to a person. Baseline sessions included the instruction to "tackle the ball carrier at the barrier cone at full speed," but other verbal instruction, feedback, or programmed consequences were not provided. During treatment phases, subjects were provided verbal instructions for the tackling component being taught prior to executing the skill and heard a beep from a megaphone when the component was performed correctly. Each tackle skill then was trained in three progressive speed phases (walk, jog, and run). The percentage of trials performed correctly dramatically increased in the intervention for all subjects. Probes of correct tackling were found to generalize, and subsequently increase, across all training phases for all subjects as well.

TAGteach alone. There have only been two studies published that examined TAGteach as a coaching strategy by itself as opposed to being part of a behavioral coaching package. First, Fogel, Weil, and Burris (2010) used TAGteach to teach a complex skill, a golf swing, to a novice golfer. To train this skill the authors broke a golf swing down into five skill sets and taught each skill set each individually. In only eight training sessions, TAGteach resulted in skill acquisition for four out of the five skill sets with the targeted golf club (5 iron) and generalized to a new club (the driver) without training. In addition, performance maintained for the target club, and the intervention was found to be socially valid (based on favorable reports by the subject in the social validity survey).

To expand the research on TAGteach as a stand-alone coaching strategy, Quinn, Miltenberger, and Fogel (2015) examined how it might be used to improve the dance skills of three dance students. This study not only included more subjects than Fogel et al. (2010) but also had the dance instructors implement the intervention rather than the researchers themselves. Similar to Fogel et al., the dependent variable was the percentage of steps (skill sets) performed

correctly for three dance movements. A task analysis was created for each target behavior (turn, kick, and leap) and data were collected from video recordings of each session. Results indicated TAGteach significantly improved targeted dance skills for all three subjects. Additionally, social validity measurements indicated consistently positive ratings from the students and teachers.

In addition to the published studies by Fogel et al. (2010) and Quinn et al. (2015), there have been a few studies conducted as master's theses that have evaluated TAGteach as a stand-alone behavioral coaching technique. For example, Andrews (2014) looked at how TAGteach might aide in skill acquisition of novice yoga practitioners. Results showed all targeted yoga skills improved after the intervention began, maintained after coaching ceased, and generalized to a new setting. In another study, Ferguson (2014) used TAGteach to enhance the specific skill sets required to execute a judo technique, the standing throw. This experiment demonstrated how the throwing performance of all subjects improved at a quicker pace during the intervention with TAGteach compared to what was observed during baseline without TAGteach. Furthermore, James (2015) used TAGteach to enhance fundamental, individualized dance movements of children with disabilities. Finally, at the other end of the age-spectrum, Hester (2015) used TAGteach to teach basic baton twirling skills to three elderly adults and found TAGteach to be an effective, and socially valid, coaching strategy for improving athletic performance.

Athlete's skill level. Another variable to consider when implementing an intervention strategy is whether the skill being taught is new or is one already in the student's repertoire. Out of the few studies mentioned above, the majority evaluated TAGteach as a coaching technique to improve athletic skill performance. To illustrate, after a known history of standard coaching, TAGteach effectively enhanced athlete's skills in: football blocking (Stokes, Luiselli, Reed, & Fleming, 2010) and tackling (Harrison & Pyles, 2013), judo throws (Ferguson, 2014), and dance

movements of children with (James, 2015) and without (Quinn et al., 2015) developmental disabilities. On the other hand, TAGteach also was successful in teaching novice skills in golf (Fogel et al., 2010), yoga (Andrews, 2014), and baton twirling (Hester, 2015).

      Skill generalization. Complying with the sixth characteristic of effective behavioral coaching suggested by Martin and Hrycaiko (1983), another important variable to consider is an intervention's social validity. One way to arrange for a socially valid treatment is to ensure the skills taught generalize to different environments. In short, an athlete should be able to take the skills learned in practice and execute them just as consistently and accurately in a game setting. Unfortunately, only two studies in TAGteach literature have assessed skill generalization in different settings. Stokes, Luiselli, Reed, and Flemming (2010) reported that the blocking skills achieved during practice drills generalized to game performance for four high school football players. Additionally, Andrews (2014) found all targeted yoga postures taught in the training setting generalized to the yoga class setting.

Statement of the Problem

Previous researchers have successfully demonstrated behavioral coaching to be an effective intervention. As suggested by Martin and Hrycaiko (1983), the methodology has remained scientific in nature by closely following the dimensions of ABA suggested by Baer et al. (1968). Based on those dimensions, Martin and Hrycaiko defined and discussed six characteristics of effective behavioral coaching. The fourth characteristic (an emphasis on coaching as a science) might arguably be the most important one and, therefore, is the foundation of the current study. To date, only eight studies have been conducted to assess TAGteach as a behavioral coaching strategy (out of the nearly 50 studies known to evaluate behavioral coaching). Even more so, only half of those eight studies have been published in peer-reviewed journals (the other half being unpublished master's thesis projects). Although empirical research to understand the effects of TAGteach has increased since the early 2000's, there still is a need for scientific evidence of replication and improvement of past studies.

TAGteach has been found to be an effective coaching technique across a variety of sports such as golf (Fogel et al., 2010), dance (James, 2015; Quinn et al., 2015), football (Harrison & Pyles, 2013; Stokes, Luiselli, Reed, & Fleming, 2010), yoga (Andrews, 2014), baton twirling (Hester, 2015), and judo (Ferguson, 2014). Of the research on TAGteach, most of the studies have evaluated it as a stand-alone coaching technique (Andrews, 2014; Ferguson, 2014; Fogel et al., 2010; Hester, 2015; James, 2015; Quinn et al., 2015). Results from studies that look at only one treatment variable are more reliable and accurate compared to studies that use multiple coaching strategies as part of a treatment package (Harrison & Pyles, 2013; Stokes, Luiselli, Reed, & Fleming, 2010). Another variable to consider when determining the efficacy of a coaching strategy is the familiarity of the skill being taught (i.e., a novel skill versus a skill that is

already in the athlete's repertoire). In the past, the effects of TAGteach have been examined more to enhance the performance of existing skills (Ferguson, 2014; Harrison & Pyles, 2013; James, 2015; Stokes, Luiselli, Reed, & Fleming 2010; Quinn et al., 2015) rather than to teach new skills (Andrews, 2014; Fogel et al., 2010; Hester, 2015). Finally, one component relevant to determining the social validity of a treatment is the generalization of the behavior. Specifically, if a skill does not generalize from the training environment to the competitive game setting, the efficacy and practicality of the coaching strategy might seem useless. Unfortunately, only two studies have included generalization data in their evaluation of TAGteach as a coaching technique (Andrews, 2014; Stokes, Luiselli, Reed, & Fleming, 2010), and only one of those evaluated the generalization of TAGteach alone rather than as part of a treatment package (Andrews, 2014).

Based on the review of previous literature, there are three treatment components that require additional research. First, researchers have yet to evaluate the efficacy of TAGteach in both improving a skill already in the athlete's repertoire and training a novel skill in the same study. Second, the generalization of the effects of TAGteach in the training environment to game conditions has only been previously examined twice, and only once with TAGteach as a stand-alone intervention. Finally, fastpitch softball is a sport that has yet to be studied in any behavioral coaching literature. Therefore, the purpose of this study is to evaluate the effectiveness of TAGteach as the single training procedure to increase the accuracy of skill components in not-yet mastered and new pitching skills by fastpitch softball pitchers.

Method

Subjects and Setting

Subjects included two female fastpitch softball athletes, Hannah (9 years old) and Megan (12 years old). Both subjects had received lessons from the researcher for about one year prior to the start of the study and were recruited from the training facility where their lessons were conducted. Once a potential subject expressed an interest in participating, the researcher reviewed the inclusion criteria with the subject and obtained informed consent from her parents. Subjects were included in the study if they had played on a competitive fastpitch softball team for at least one year prior to the study, actively participated in team practice and games throughout the study, and did not have any injuries before beginning the study. Both Hannah and Megan were training to improve a pitch they could perform but had not yet mastered (fastball). Megan was also learning a new pitch (change-up).

The study took place at the same fastpitch softball training facility where the researcher (who has played at the Division I collegiate-level and worked at the training facility for over five years) gave lessons at the time. The training facility was an indoor warehouse-like building with hanging lights and air-conditioning units. The pitching lanes consisted of turf floors with a pitching rubber mat secured to the floor.

Materials

The following materials were used in this study: an 11 or 12-in fastpitch softball (depending on subject's age), a Club K PowerLine Pitching Mat, an iPad for video recording, and a tagger. The tagger was a hand-held clicker, small enough to fit in the palm, and was purchased at a pet store.

Response Measurement and Interobserver Agreement

The dependent variables were the percentage of each skill set performed correctly for the specific pitch being trained. The researcher created a task analysis of each pitch, individualized for both subjects, to identify the specific skill sets so the component behaviors (tagpoints) could be easily recognized and tagged (refer to the Appendix A, B, and C for Hannah's fastball, Megan's fastball, and Megan's change-up task analyses, respectively). Data were collected via video recordings of each session so the researcher and researcher's assistant could independently score the target behavior via task-analyzed checklists. Percentages of each skill set were calculated by dividing the number of steps performed correctly by the number of steps in the task analysis.

Interobserver agreement (IOA) data were collected for 30%, 33%, and 35% of all data collection opportunities for Hannah's fastball, Megan's fastball, and Megan's change-up, respectively. A research assistant was trained to score the targeted skill sets of all pitches with practice videos of a variety of fastpitch softball pitchers. The assistant's ability to correctly complete the task analyses was tested and compared with the researcher's scoring. The research assistant achieved better than 80% agreement with the instructor before collecting data without supervision. The assistant then viewed video footage independently and scored each skill set component as either correct or incorrect on the task analysis. The percentage of IOA was calculated by dividing the number of agreements (both observers scoring a target behavior as correct or incorrect) by the number of skill components for each pitch and multiplying by 100. The mean IOA for Hannah was 97% (range, 90% to 100%). For Megan's fastball, mean IOA was 94% (range, 80% to 100%). Mean IOA for Megan's change-up was 97% (82% to 100%).

Experimental Design and Procedure

A multiple baseline design across skill sets was used to evaluate the effects of TAGteach for each subject's learning and development of a new (Megan) or not-yet-mastered (Megan and Hannah) pitch. The procedure for this study closely followed the experimental sequence and design from Fogel et al. (2010).

Baseline. In baseline, subjects were simply asked to "show me your fastball/change-up" (depending on their targeted pitch) five to 10 times without any feedback from the researcher regarding their performance. Baseline data for the first skill set were collected from these pitches. Baseline data for the not-yet-targeted skill sets were also recorded from these initial pitches and continued to be recorded from the videos where TAGteach was implemented on the skill set(s) before them. To illustrate, using the task analysis in for Megan's fastball (Appendix B), baseline data for all five skill sets (Presentation, Wind Up, Power X, Release, and Finish) were obtained via the first 10 pitches of the first session. Baseline data for Wind Up, Power X, Release, and Finish were collected from the same pitches in which TAGteach was being implemented for the Presentation skill set. Baseline data for Power X, Release, and Finish were collected from the same pitches where TAGteach was implemented for the Wind Up skill set. Release and Finish baseline data were collected from the same pitches where TAGteach was implemented for the Power X skill set, and so on. In short, baseline data were collected for every skill set until intervention was implemented.

TAGteach. During the intervention conditions, subjects received training on each skill set for their targeted pitch via TAGteach methodology, as defined by TAGteach International (2004). The researcher became trained and certified in the TAGteach methodology prior to the start of the study and conducted each session in accordance to TAGteach standards.

In the first training session, the researcher introduced TAGteach to the subject by explaining how the tagger worked, answering questions the subject had about the process, and allowing the subject to play a couple of games to become familiar with the tagger. The first game included subjects having to tag certain words in a song. In the second, subjects had to tag when the instructor would hold up a specified number of fingers. When the subjects tagged the instructor's behavior correctly, they received praise in the form of verbal statements such as "good job," or "you've got it!" This interaction allowed the subjects to further understand the click of the tagger meant "yes, correct," and the absence of the click meant "not correct, try again." Because both subjects had previously received pitching lessons from the researcher for over a year, praise from the instructor had been established as a reinforcer. The sound of the tagger was expected to be reinforcing for the subjects due to it initially being paired with praise from the instructor. Praise was faded before intervention began so the sound of the tagger alone was the primary source of reinforcement for performing a skill correctly.

During each training session, the researcher told the subject which skill set was being learned, explained and modeled the components being tagged from the task analysis, and reviewed the TAGteach rules (TAGteach International, 2004) as needed. As a tagpoint was performed correctly, it was tagged without any verbal feedback. It is important to note that only one tagpoint was trained at a time. For example, if the tagpoint was "drive forward", the researcher would only provide a tag if that skill component was performed correctly regardless of how the skills before and after were performed. A tagpoint had to be performed correctly three consecutive times before it was added to the response chain and the next skill set component could be taught. If the subject could not perform the skill component correctly in three

consecutive attempts the researcher would review the task analysis again and allowed for additional repetitions.

Around 20 min before instruction began was allotted for warmups and review of tagpoints from the previous session(s). Then, training with TAGteach lasted about 30 min. After instruction ended, 10 min was allotted for any additional questions. Although frequency of sessions varied between subjects, they were typically conducted weekly or bi-weekly. Similarly, total amount of pitch attempts varied across sessions and between pitchers. On average, Hannah received training on nine to fourteen pitches each session. Because Megan received training on fastball and change-up pitches during each session, she averaged five to nine attempts (for each pitch) each session. To illustrate further, Megan would first begin and finish TAGteach training for her fastball (around five to nine pitches) and then begin and finish TAGteach training for her change-up (around five to nine pitches) each time she met with the researcher.

While TAGteach was the only intervention systematically implemented, and evaluated, it is important to note that video feedback, modeling, and instructions were used in this study as necessary. Modeling and instructions are an inherent part of using TAGteach as a training procedure. As described previously, when a new tagpoint was introduced the researcher had to explain and model the skill so the subject understood how to perform it. If the tagpoint was "rock back", for example, the researcher would show the subject each movement and simultaneously describe what she was doing. Outside of the initial modeling and instructions, these strategies were also used when the subject could not perform the skill three time in a row to meet criterion. If the subject was having a hard time performing the skill consistently the researcher would again model and explain the key movements. Also, as an additional tool, the researcher would let the subject watch herself pitch from a video recording. This video feedback allowed the subject to

see what she looked like performing a skill correctly or incorrectly. Video feedback was used infrequently during the study (i.e., no more than five times total for Hannah's fastball or Megan's fastball and change-up).

Maintenance. During the maintenance phase, TAGteach was no longer implemented. Maintenance data were collected to determine if improved performance maintained once TAGteach was removed across skill sets. Similar to baseline data, maintenance data on previously trained skill sets were obtained by scoring the same pitches where TAGteach was being implemented on a later skill component. To illustrate, once TAGteach had been implemented for the Presentation skill set, the next skill set (Wind Up) would receive TAGteach. As the first skill component in Wind Up received TAGteach, maintenance data was collected on Presentation (the previously trained skill set). Likewise, when TAGteach was implemented on the Power X skill set, maintenance data on Presentation and Wind Up skill sets were collected.

Generalization. Generalization probes were measured throughout the duration of the study to evaluate the effects of TAGteach in competition situations. The subjects were video recorded at two separate times each (at various times of the day, at different fields, against different opponents, etc.) for two to four consecutive pitches. The video recordings, taken by the subject's parents, were given to the experimenter and data were collected on each skill set with the same task analysis used in TAGteach training. Game probe data were recorded less frequently than originally planned due to various reasons (e.g., parents forgetting, not attending games regularly, subject not pitching during games frequently).

Treatment integrity. To assess how consistently TAGteach was implemented, treatment integrity was calculated for 80% of total pitch attempts for Hannah's fastball, Megan's fastball, and Megan's change-up. Treatment integrity was measured by dividing number of agreements

by total number of pitch attempts. An agreement consisted of the sound of the tagger and the tagpoint being performed correctly (or no sound of the tagger and the tagpoint being performed incorrectly). The same research assistant that collected IOA data collected treatment integrity data by independently observing recorded videos of training sessions. IOA and treatment integrity data were collected independent of each other.

Social validity. A social validity assessment was conducted upon completion of the study to evaluate subject perception of TAGteach as a training procedure (see Appendix D). The social validity form, like that used by Quinn et al. (2015) and Fogel et al. (2010), consisted of a Likert scale and open-ended questions pertaining to the likeability, feasibility, and perceived effectiveness of TAGteach training.

Results

The purpose of this study was to determine whether TAGteach can be an effective

training procedure to increase correct skill-set performance of both novice (learning a new pitch)

and advanced (improving performance of a pitch not-yet mastered) softball pitchers. Results

shown in Figures 1-3 demonstrated performance increased when TAGteach was implemented for

both Hannah's fastball (not-yet mastered) and Megan's fastball and change-up (not-yet mastered

and new, respectively). Results also showed trends in performance improved not only for each

skill set (i.e., Presentation, Wind Up, Power X), but each skill component within the skill sets

(see Appendices for more detail), when TAGteach was implemented. Game probe data also were

collected to evaluate generalization of treatment effects for Hannah's and Megan's fastball.

Game performance improved for Megan for the skill sets that received TAGteach, while game

performance was more variable for Hannah. Overall, it is difficult to determine if treatment

effects generalized because there were not enough game probe data collected throughout the

study for both subjects.

Results for Hannah are shown in Figure 1. In the baseline condition, for the first skill set

(Presentation), 50% of the skill components were performed correctly. Because the first skill

component already was performed correctly (feet) we began treatment on the second (and last)

component (together). Although there are no data to demonstrate the improvement during this

phase (as the video was accidentally deleted), performance for Presentation maintained at 100%

accuracy for the remainder of the study, as shown in the top portion of Figure 1. After

performance for the Presentation skill set remained stable for three consecutive pitches, we

implemented TAGteach on the second skill set (Wind Up). Baseline data showed 0% of the skill

set was performed correctly, which included three skill components (rock back, drive down, and

drive forward). Once the first skill received TAGteach, performance improved quickly to 33% and remained stable for more than three consecutive pitches. We then moved onto the second skill, where performance improved quickly and maintained at 67%. At the end of this phase, game probe data were collected and showed performance in the Presentation and Wind Up skill sets was at 100% while performance stayed at the same level as baseline for the skill sets that had not yet been tagged. Finally, TAGteach was implemented on the third skill component of the Wind Up skill set. Although this skill component required more attempts to achieve stable responding compared to the previous components, performance eventually reached 100% and remained stable for eight consecutive attempts. Game probe data did not reflect this performance, though, and dropped down to 33% correct during this phase. Performance was generally the same as the previous game probes for the other skill sets. TAGteach was not implemented on the last three skill sets for Hannah (Power X, Release, and Finish) as the behavior became more complex and was occurring too quick for the researcher to accurately tag. (This problem will be addressed further in the discussion.)

Results for Megan's fastball task analysis (not-yet mastered) are displayed in Figure 2. Like Hannah, baseline performance was already at 50% for the first skill set. When TAGteach was implemented for the second skill component, performance improved to 100% and maintained for every pitch after. Once data were stable, we implemented TAGteach with the next skill set (Wind Up), where baseline performance was at 0%. When the first skill component began being tagged, performance for the skill set improved to 33% with the first attempt but then was at 67% accuracy for the last three pitches. We began TAGteach for the second component, and performance remained stable at 67%. Finally, the third skill was tagged and, although somewhat variable initially, performance reached 100%. As TAGteach was implemented on the

third skill set (Power X) maintenance performance for the Wind Up skill set had a mean of 90%.

Although we began intervention for the first skill component of the Power X skill set, no

improvement was achieved. Performance improved to 50% with the second and third attempt but

dropped back down to 0% for the following 12 attempts. As mentioned above, the behaviors in

this skill set were too complex and quick for the instructor to implement TAGteach accurately,

therefore it was not effective. Treatment integrity for this skill component alone was 33%,

meaning the researcher only delivered the tag reliably for five out of the fifteen pitch attempts.

This further demonstrates why we decided to stop implemented TAGteach at that point. Game

probe data demonstrated that performance improved, overall, in games when TAGteach was

implemented during practice. In baseline, game performance was at 50% and 0% for the

Presentation and Wind Up skill sets, respectively. Once TAGteach began, game performance

improved to 100% for Presentation and a mean of 83% for Wind Up.

Figure 3 shows results for Megan's change-up task analysis (new). In the task analysis

for Megan's change-up, the Presentation skill set consisted of three skill components (feet,

together, and grip). Before beginning TAGteach, baseline performance was at 33% for this first

skill set for 10 consecutive pitch attempts. TAGteach was provided for the second skill for seven

pitches, five of which met 67% and two reached 100% performance. The third skill acquired

100% accurate performance for five consecutive pitches before TAGteach was applied to the

next skill set. As the other skill sets received treatment, Presentation performance maintained a

mean of 93% throughout. Although baseline data for the Wind Up skill set were at 0% initially,

it reached 67% before TAGteach was even introduced. This might have been because the skill

components for the Wind Up skill set are exactly the same for both Morgan's fastball and

change-up task analysis, which were being trained in the same sessions as each other. Once

TAGteach was introduced, the first skill component of Wind Up stayed at 67% for all five pitches. For the first pitch when TAGteach was implemented on the second skill, performance reached 100% but dropped back down to 67% for the last two pitches (which met criterion for that component of the task list). Criterion also was reached (100%) for the third skill and maintained for each pitch after as well. Once stable performance was achieved for the final skill component of Wind Up, we moved to the first skill of the next skill set (Power X). In the same way that training ended for Megan's fastball previously, we had to stop training for her change-up during this phase due the complexity and speed of this later behavior. The first attempt at TAGteach in Power X did increase performance to 50%, although it decreased and stayed at 0% for the four pitches after. Similar to Megan's fastball, treatment integrity measures were low (20%) when TAGteach was implemented on this skill component. Game probe data were not collected for Megan's change-up, as she had not thrown it in any games before the study concluded.

Treatment Integrity

For Hannah, TAGteach was implemented with integrity for 83% of total pitch attempts. All errors of commission (skill was tagged when performed incorrectly) and omission (skill was not tagged when performed correctly) occurred during the drive forward skill component of the Wind Up skill set. For Megan's fastball, TAGteach was implemented with integrity for 70% of total pitch attempts. All but two errors of commission and omission occurred during the power x skill component. Similarly, for Megan's change-up treatment integrity was 84% with all errors (only commission) occurring in the power x component.

Social Validity

Based on feedback collected via a social validity survey (see Appendix D), both subjects reported TAGteach to be a socially acceptable training method. Responses to all questions are displayed, in a randomized order, in Table 1.

Discussion

For all three pitches (Hannah's fastball, Megan's fastball and change-up), the TAGteach intervention resulted in substantially higher percentages of correct performances for the skill sets in which it was implemented when compared to baseline performance. In addition, once stable levels of responding were achieved in each skill set and TAGteach was no longer being implemented (maintenance), performance never returned to baseline levels. Finally, game probe data demonstrated treatment effects might have generalized and maintained outside of the training environment. However, there was not enough experimental control to determine generalization effects with certainty as game probe data were not collected frequently enough. Nevertheless, treatment effects were not only favorable from a scientific standpoint, but the social validity reports found TAGteach to be enjoyable, helpful, and likely to be continually used by both subjects. Results from this study indicate the effectiveness and efficiency of the TAGteach intervention for further developing and/or enhancing the pitching skills, specifically for the beginning of the wind up, of novice-to-advanced fastpitch softball pitchers.

Figures 1 and 2 (Hannah's and Megan's fastball, respectively) both show levels of performance across skill sets and skill components improved when TAGteach was introduced. For Megan's change-up performance, specifically in the Wind Up skill set, accuracy of performance increased before TAGteach was implemented. The lead investigator suspects that this might be a result of carryover effects from training on Megan's fastball, which was training in the same sessions as the change-up and had a similar task analysis. While this effect might not be favorable in demonstrating experimental control, it is something that can be beneficial for an instructor and the pitcher. If training skills of one pitch also improves performance of a different pitch, less time might be required to learn those additional skills.

This study supplements previous results suggesting that TAGteach is a useful tool in sport performance (Fogel et al., 2010; Hester, 2015; Quinn et al., 2015). Based on an extensive review of the literature, these findings add to the behavioral coaching literature in three ways. First, this is the first study to evaluate a behavioral coaching technique in the sport of fastpitch softball. Fastpitch softball has become more popular over the past few years, and there are many different avenues for behavioral coaching techniques to aid in the development and acquisition of skills in young softball athletes. Second, this is the first study to evaluate the efficacy of TAGteach in both improving a skill already in the athlete's repertoire and training a novel skill in the same study. Third, and possibly adding the most social validity, this is only the second study to evaluate generalization of intervention effects in the training environment to game settings, when TAGteach was the only treatment component. Additionally, TAGteach has been demonstrated to be a promising intervention for fastpitch softball training in that is it easily accessible, can be implemented in most training environments, and can be modified to fit the specific needs of the athlete, coach, and/or team.

Limitations

Although ultimately successful, there were a few unexpected limitations of the study which warrant discussion. First, we were not able to implement TAGteach on the last half of each subject's pitch because of how quick and complex the behaviors were. Because TAGteach derives entirely from delivering reinforcement as soon as the behavior occurs, if errors of omission and/or commission occur it is possible you are less likely to obtain sufficient results. The primary researcher recognized almost immediately she could not implement TAGteach with 100% accuracy, as the later skill sets increased in complexity and occurred much more quickly.

To support her anecdotal report, a quick visual analysis of the data at Power X (Megan's fastball and change-up) shows no improvement in performance when TAGteach was introduced.

Another limitation of this study was that fewer game probe data points were collected than originally planned, leaving questions about generalization of skills to the game setting. The primary researcher decided to have the parents of each subject record game videos for her because it was not always feasible for her to travel to games for both subjects regularly. Unfortunately, this lead to parents not recording during the time frames they were asked to or the videos not being of sufficient quality (e.g., angles were difficult to complete task analysis, images were blurry, etc.). Without enough game probe data collected, specifically during baseline phases, it is difficult to compare performance during games before and after the training procedure.

A final limitation of this study was the time to complete it. Megan's data collection lasted about four months, and Hannah's data collection lasted about seven months. Although the total time frame for data collection took a while, Megan only had a total of 55 and 41 attempts for her fastball and change-up, respectively, and Hannah had a total of 70 attempts for her fastball. Therefore, it is difficult to say whether this is a limitation of the study itself, or a result of scheduling conflicts that are common with private lessons. For example, there were times when subjects could not make it every week for a lesson, such as during holidays or when their teams played/practiced every weekend and throughout the week.

Future Research

As this was the first study reported to use behavioral coaching techniques (specifically TAGteach) with fastpitch softball pitchers, there are many potential avenues for future research. First, researchers should evaluate TAGteach as a technique to improve specific aspects of a

pitch, rather than attempting to work from beginning to end. For example, if an instructor notices her student struggling to perform one part of her finish accurately and consistently (such as pointing her elbow), TAGteach might be a helpful tool for this. Rather than using TAGteach as a stand-alone training technique, it might be even more useful as a supplemental tool to further advance a trainer's typical pitching lesson. Researchers could also evaluate TAGteach effectiveness with practice drills of portions of the pitch, rather than only with the full windup.

Another area for future research might be measurements of other, or additional, dependent variables. For example, instead of only measuring TAGteach effects on the percentage of skill sets performed accurately, one might also measure speed and accuracy of the pitch. This would require careful consideration of the behaviors which control such outcomes to include as tagpoints.

Furthermore, researchers should continue to replicate effects of TAGteach on improving pitching skills with novice-to-advanced softball pitchers. While this was the first study to include training which enhanced skills already in the subject's repertoire and training of a novel pitch in the same study, this was done within the same subject (Megan). While the data demonstrated TAGteach was successful in improving Megan's fastball skill set performance and teaching an entirely new pitch (change-up), it is possible there were carryover effects from one pitch to the other because the task analyses were similar and both pitches were trained in the same session. Future research should include subjects who are receiving training on advanced and novel pitches, so there is at least one subject who is training only to further develop a pitch and one subject who is training only to learn a new pitch. Research might also include subjects at different age levels (high school or college), with different pitches (besides fastball and change-up) and/or have instructors besides the primary researcher conduct training sessions.

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Tables

Table 1

Subject's Social Validity Survey Responses

| Question	Responses
1. How did the TAGteach procedure compare to a typical pitching lesson as far as perceived difficulty and fun?	It pushed me harder and got me to be more confident in myself. We went more into depth with pitching techniques and why each one is important.
2. What did you enjoy most about the training?	Teaching proper techniques for pitching. Made me think more before I did a step because I wanted to hear that click. I enjoyed it when I didn't get a click and next time I got one because I recognized what my problem was.
3. What, if anything, did you dislike about the TAGteach training or what would you change?	I did not dislike anything. There is nothing that I disliked about the TAGteach training.
4. Would you recommend this training to a friend?	I would definitely recommend this to a friend so that that their confidence can rise and they can progress on their pitching. Yes.
5. Other comments?	Girls just starting out pitching should use this. None.
6. My pitching skills have improved following the TAGteach intervention.	4 (agree) 5 (strongly Agree)
7. I am more confident with my pitching skills in games.	4 (agree) 5 (strongly Agree)
8. I would like my coach and/or future coaches to train my using TAGteach again.	5 (strongly Agree) 5 (strongly Agree)

Figures
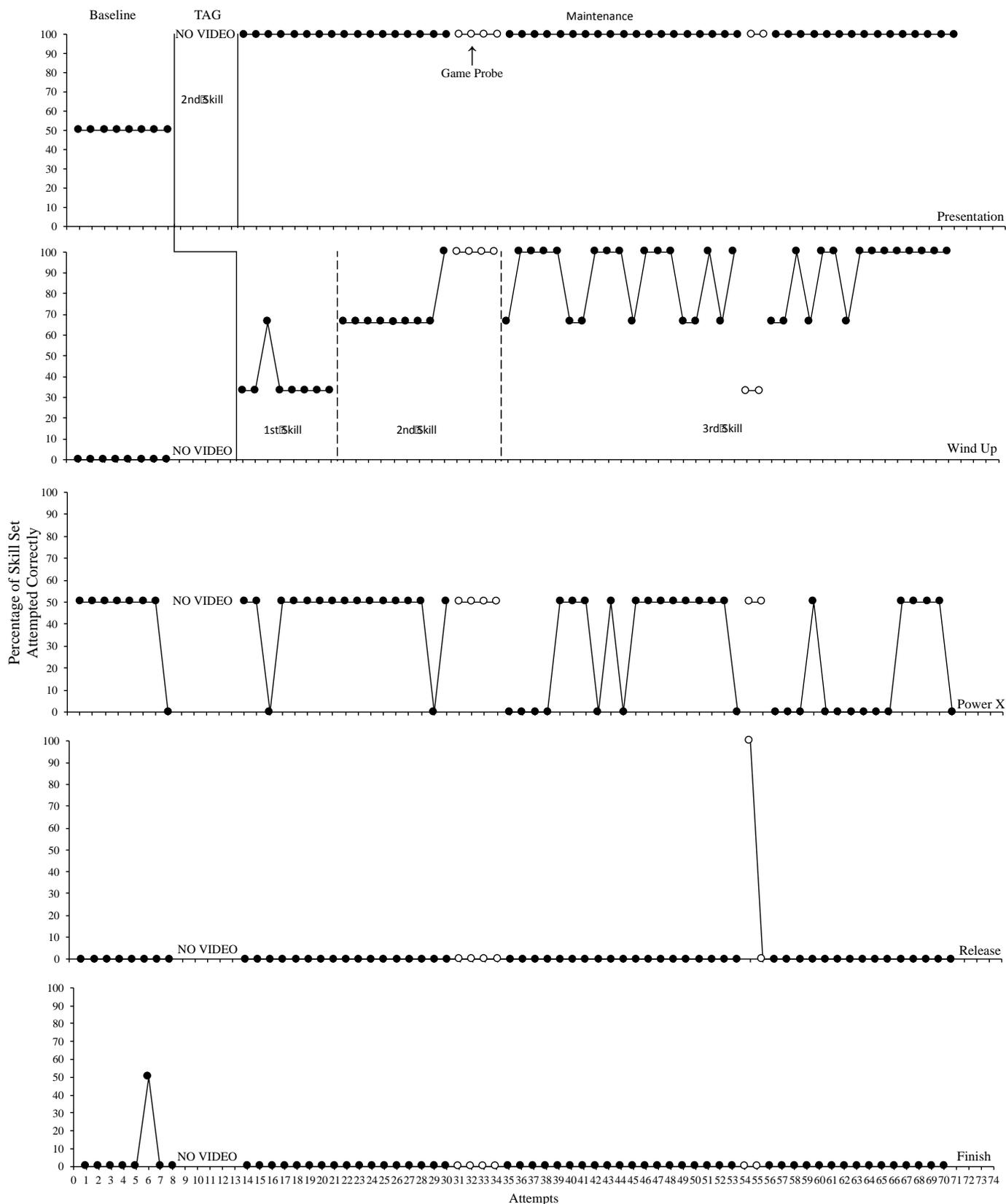
Figure 1. Percentage of fastball task analysis performed correctly during baseline, intervention, and maintenance for Hannah. First solid lines depict when TAGteach was implemented for that skill set. Dashed lines depict when TAGteach was implemented for each skill component within the skill set. Presentation had two skill components and Wind Up had three skill components. Last solid lines depict when TAGteach was no longer being implemented on any components in that skill set, therefore data points following show maintenance level of performance.

Figure 2. Percentage of fastball task analysis performed correctly during baseline, intervention, and maintenance for Megan. First solid lines depict when TAGteach was implemented for that skill set. Dashed lines depict when TAGteach was implemented for each skill component within the skill set. Presentation had two skill components, Wind Up had three skill components, and Power X had two skill components. Last solid lines depict when TAGteach was no longer being implemented on any components in that skill set, therefore data points following show maintenance level of performance.
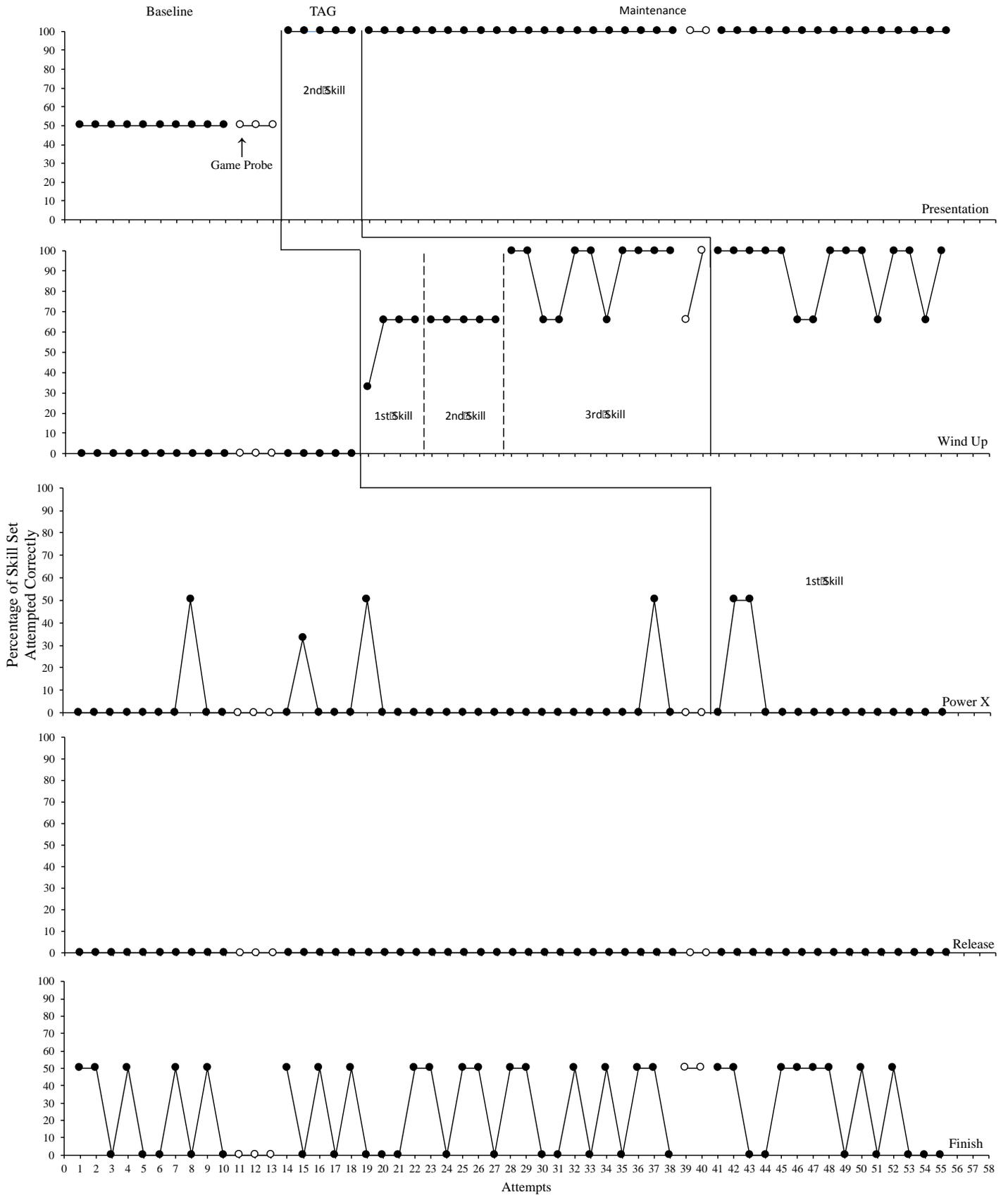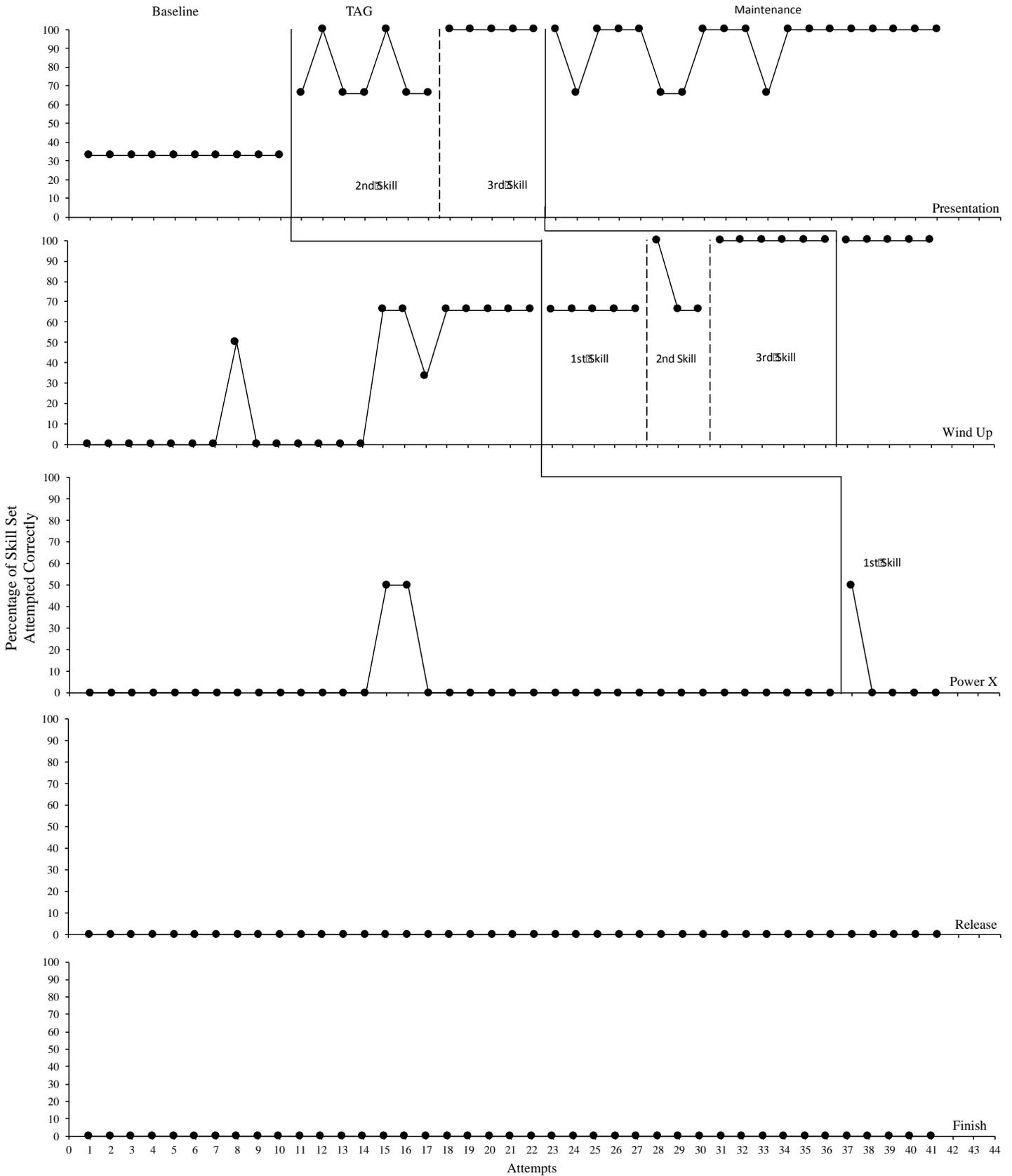
Figure 3. Percentage of change up task analysis performed correctly during baseline, intervention, and maintenance for Megan. First solid lines depict when TAGteach was implemented for that skill set. Dashed lines depict when TAGteach was implemented for each skill component within the skill set. Presentation had three skill components, Wind Up had three skill components, and Power X had two skill components. Last solid lines depict when TAGteach was no longer being implemented on any components in that skill set, therefore data points following show maintenance level of performance.

Appendix A: Task Analysis and Data Sheet for Hannah (fastball)

Skill Set: Presentation	TAGpoint	✓ = correct X = incorrect
1. Start with both feet contacting the mound (throwing foot at the front, glove foot staggered behind)	Feet	
2. Throwing hand with ball inside glove, resting waist height in front of body	Together	
Skill Set: Wind Up		
1. Shift weight back on glove foot; dorsiflexion of throwing foot; simultaneously lift glove hand with ball in throwing hand over head	Rock back	
2. Swing both arms down (throwing arm behind body, glove arm contacts throwing leg); throwing foot remains in dorsiflexion until throwing arm passes waist	Drive down	
3. As arms begin to swing forward, simultaneous plantarflexion of throwing foot; chest, hips, and toes of throwing foot remain facing target	Drive forward	
Skill Set: Power X		
1. Arms swing up above head, glove leg simultaneously lifts off mound and strides forward; hips and shoulders open (facing third base if right handed) to extended X position (glove foot lightly contact ground, straight; throwing foot stays in contact with ground; both feet on power line); upper body is tall (chest/shoulders in line with hips)	Power X	
2. Glove arm pointing towards target; throwing arm pointing towards second base; both arms straight	Arms	
Skill Set: Release		
1. Both arms continue down beside body (straight glove arm contacts glove hip, straight throwing arm in front of throwing hip); wrist snaps forward towards target; throwing leg simultaneously drags under body towards planted, straight glove foot; upper body remains tall	Snap	
Skill Set: Finish		
1. After ball leaves throwing hand, arm continues forward, throwing elbow points towards target; glove arm hangs down beside glove hip	Elbow	
2. Throwing leg continues to drag under body (within width of rubber/stays inside white lines) towards planted, straight glove leg; throwing foot maintains contact with ground until throwing knee and glove knee contact; upper body remains tall	Figure four	

Appendix B: Task Analysis and Data Sheet for Megan (fastball)

Skill Set: Presentation	TAGpoint	✓ = correct X = incorrect
1. Start with both feet contacting the mound (throwing foot at the front, glove foot staggered behind)	Feet	
2. Throwing hand with ball inside glove, resting waist height in front of body	Together	
Skill Set: Wind Up		
1. Shift weight back on glove foot; dorsiflexion of throwing foot; simultaneously lift glove hand with ball in throwing hand over head	Rock back	
2. Swing both arms down and behind body, throwing foot remains in dorsiflexion until throwing arm passes waist	Drive down	
3. As arms begin to swing forward, simultaneous plantarflexion of throwing foot; chest, hips, and toes of throwing foot remain facing target	Drive forward	
Skill Set: Power X		
1. Arms swing up above head, glove leg simultaneously lifts off mound and strides forward; hips and shoulders open (facing third base if right handed) to extended X position (glove foot lightly contact ground, straight; throwing foot stays in contact with ground; both feet on power line); upper body is tall (chest/shoulders in line with hips)	Power X	
2. Glove arm pointing towards target; throwing arm pointing towards second base; both arms straight	Arms	
Skill Set: Release		
1. Both arms continue down beside body (straight glove arm contacts glove hip, straight throwing arm in front of throwing hip); wrist snaps forward towards target; throwing leg simultaneously drags under body towards planted, straight glove foot; upper body remains tall	Snap	
Skill Set: Finish		
1. After ball leaves throwing hand, arm continues forward, throwing elbow points towards target; glove arm hangs down beside glove hip	Elbow	
2. Throwing leg continues to drag under body (within width of rubber/stays inside white lines) towards planted, straight glove leg; throwing foot maintains contact with ground until throwing knee and glove knee contact; upper body remains tall	Figure four	

Appendix C: Task Analysis and Data Sheet for Megan (change-up)

Skill Set: Presentation	TAGpoint	✓ = correct X = incorrect
1. Start with both feet contacting the mound (throwing foot at the front, glove foot staggered behind)	Feet	
2. Throwing hand with ball inside glove, resting waist height in front of body	Together	
3. Adjusts grip inside of glove (still resting waist height); glove covers ball and hand	Grip	
Skill Set: Wind Up		
1. Shift weight back on glove foot; dorsiflexion of throwing foot; simultaneously lift glove hand with ball in throwing hand over head	Rock back	
2. Swing both arms down and behind body, throwing foot remains in dorsiflexion until throwing arm passes waist	Drive down	
3. As arms begin to swing forward, simultaneous plantarflexion of throwing foot; chest, hips, and toes of throwing foot remain facing target	Drive forward	
Skill Set: Power X		
1. Arms swing up above head, glove leg simultaneously lifts off mound and strides forward; hips and shoulders open (facing third base if right handed) to extended X position (glove foot lightly contact ground, straight; throwing foot stays in contact with ground; both feet on power line); upper body is tall (chest/shoulders in line with hips)	Power X	
2. Glove arm pointing towards target; throwing arm pointing towards second base; both arms straight	Arms	
Skill Set: Release		
1. Both arms continue down beside body (straight glove arm contacts glove hip, straight throwing arm in front of throwing hip); palm opens to release ball, wrist remains straight; throwing leg simultaneously drags under body towards planted, straight glove foot; upper body remains tall	Pop Open	
Skill Set: Finish		
1. After ball leaves throwing hand, straight arm, hand, and fingers extend out towards target (end about waist height); glove arm hangs down beside glove hip	Extend	
2. Throwing leg continues to drag under body (within width of rubber/stays inside white lines) towards planted, straight glove leg; throwing foot maintains contact with ground until throwing knee and glove knee contact; upper body remains tall	Figure four	

Appendix D: Subject Post-Study Survey

1. How did the TAGteach procedure compare to a typical pitching lesson as far as perceived difficulty and fun?					
2. What did you enjoy most about the training?					
3. What, if anything, did you dislike about the TAGteach training or what would you change?					
4. Would you recommend this training to a friend?					
5. Other comments?					
	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
My pitching skills have improved following the TAGteach intervention.	1	2	3	4	5
I am more confident with my pitching skills in games.	1	2	3	4	5
I would like my coach and/or future coaches to train my using TAGteach again.	1	2	3	4	5