Using a Behavioral Intervention to Improve Performance of a Women's College Lacrosse Team

Jesse DePaolo¹ · Nicole E. Gravina¹ · Celeste Harvey¹

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Abstract

This study examined the use of prompting and an interdependent group negative reinforcement contingency to improve performance of 12 collegiate women's lacrosse players. The team coaches wanted players to “name passes,” defined as saying the name of a player who should catch the ball at least 1 s before the catch. The intervention was evaluated using an A-B-A-B design, and results indicated that prompting and negative reinforcement (removing sprints at the end of practice for desired performance) were successful for improving names on passes. Players rated the intervention as acceptable, but only 7 out of 12 thought it should continue to be used in future practices.

Keywords Sports · Negative reinforcement · Lacrosse · College athletes · Performance diagnostic checklist · PDC

Behavior analysis research related to improving sports performance spans over three decades (Luiselli, Woods, & Reed, 2011). Research includes athletes from a wide range of sports, such as football (Smith & Ward, 2006; Stokes, Luiselli, & Reed, 2010), baseball (Osborne, Rudrud, & Zezoney, 1990), swimming (Hume & Crossman, 1992), and gymnastics (Boyer, Miltenberger, Batsche, & Fogel, 2009). In addition, research covers a wide range of skill levels from beginner youth (Koop & Martin, 1983) to proficient professional athletes (Reed, Critchfield, & Martens, 2006). Common interventions include positive reinforcement, goal setting, graphic feedback, self-talk, and modeling, all of which show great promise for improving athletic performance. Athletic coaches also commonly use procedures such as positive punishment, negative punishment, and negative reinforcement—for

instance, requiring players to repeat exercise drills, run extra laps, or sit out during a game, contingent upon breaking rules, drawing penalties, or engaging in poor performance (Lavay, French, & Henderson, 2016). Although positive reinforcement-based interventions typically represent best practice in behavior analysis, a paucity of research exists on the effects of other procedures commonly applied to sports-related skills.

Behavior analysis research related to sports also rarely includes formal assessments designed to select appropriate intervention procedures. One assessment tool that may be applied to sports is the Performance Diagnostic Checklist (PDC; Austin, 2000). The PDC is an informant assessment used to identify potential interventions and covers four areas: (a) antecedents and information, (b) knowledge and skills, (c) equipment and processes, and (d) consequences. Although it was designed for use in organizations, it can be applied to sports teams by substituting “player” for “employee” and “coach” for “supervisor.”

The present study employed the PDC and sought to evaluate the effects of prompting and an interdependent group negative reinforcement contingency during practice to increase college women's lacrosse players' “pass naming,” or shouting the name of an intended receiver before a pass is caught. During intervention, coaches prompted players to name passes every 4–6 min. The interdependent group negative reinforcement contingency involved the removal of up to five required daily sprints for engaging in a preset criterion level of pass-naming responses. Women's lacrosse is

Research Highlights

- Behavior analysis can be applied to positively impact sports performance at the collegiate level.
- The Performance Diagnostic Checklist (PDC) may be useful in selecting interventions for improving sports team performance.
- Prompting and an interdependent group negative reinforcement contingency can be an effective strategy for improving team performance.

✉ Nicole E. Gravina
ngravina@fit.edu; nicole.gravina@me.com

¹ School of Behavior Analysis, Florida Institute of Technology, 150 West University Blvd, Melbourne, FL 32901, USA

a fast-paced sport, and several passes can occur in seconds as players advance toward the goal line. Passing is critical for moving the ball down the field and creating shooting opportunities. Passes generally occur while players are running, and therefore alerting players to incoming passes potentially increases the likelihood of the ball being caught and proper positioning for the next move after the catch.

Method

Participants and Setting

Twelve female players participated in the study. The players included attackers and midfielders on the women's varsity lacrosse team at a university in the south-eastern United States. The women ranged in age from 18 to 22 years old with lacrosse experience from 4 to 10 years. Sessions occurred during the last half hour of full practices on the team's practice field, 3–5 days per week, and data collection occurred in the second half of the team's season. Institutional review board (IRB) approval was obtained for this study.

Dependent Variable and Data Collection

The primary dependent variable for this study involved "named passes," defined as a player saying the name of an intended receiver at least 1 s before the receiver made the catch. Instances when a player called a name when the ball was already caught, or in the process of being caught, were not counted. The goal of increasing named passes was to alert a player to an incoming pass and thereby increase the likelihood of catching the pass and proper positioning for the next move. Each session occurred during an end-of-practice scrimmage and lasted for 100 passes, which took approximately 10–20 min. No individual data were collected, due to the fast pace of the sport and difficulty with discriminating between players' voices on the field. Instead, each data point represents team performance. A defensive player, who also served as first author on this article, collected data during all sessions using the pencil-and-paper method. The data collector recorded each pass and whether a name was called before the ball was caught.

Procedure

The team's two coaches requested assistance with improving pass naming during practices to increase awareness of intended receivers and potentially improve receptions and positioning during the catch. The coaches noted that women's collegiate lacrosse rules have begun to change, encouraging

more frequent passing (i.e., within 90 s), and top-performing teams regularly name passes. The PDC (Austin, 2000) with some minor modifications (i.e., replacing "employee" with "player" and "supervisor" with "coach") was completed by a researcher, with the help of the coaches, to identify potential interventions. Ratings indicated the players understood the expectation to name passes to alert receivers, as well as the need to do so at least 1 s prior to a reception. Equipment and processes did not appear to be a barrier either. Thus, the PDC identified antecedents and consequences as most in need of improvement.

During baseline, players participated in scrimmages, or simulated game play, during practice in their usual manner. Scrimmages typically lasted for 30 min or longer and involved an offense-versus-defense configuration.

At the start of the first intervention phase, a researcher met with the team and explained the goals and purpose of the study. Players were told data had been collected and would continue to be collected during the end-of-practice scrimmages. Next, the coaches informed the team that they would run five 65-yard sprints at the end of each practice, but for every 20 times they named passes (during the 100 counted), they would do one less sprint. Therefore, they could run between zero and five sprints, depending on how many named passes out of the 100 observed occurred during the scrimmage. The coaches selected these parameters because they believed that five sprints were a reasonable requirement at the end of practice and that 100 passes could be readily observed during every scrimmage, which resulted in the contingency of subtracting one sprint per 20 named passes. During baseline, players did not run sprints at the end of practice, and therefore the sprints were added as part of the intervention. The coaches provided an operational definition of naming passes and asked if players had any questions. During intervention, coaches also prompted players to name passes every 4–6 min.

At the start of the second baseline phase, coaches informed players that the contingency would not be in effect for the next few practices and sprints would no longer occur at the end of practice. At the start of the second intervention phase, the coach described the interdependent negative reinforcement contingency to the players again and returned to prompting players to name passes every 4–6 min.

Experimental Design

An A-B-A-B reversal was employed for this study. Four sessions were conducted in each of the first three phases, whereas the last phase consisted of two sessions due to the lacrosse season ending.

Interobserver Agreement

The team's athletic trainer and a second observer collected interobserver agreement data for the last session of each phase, which made it easy for him to remember when to be available. Interobserver agreement data were scored for 30% of all sessions, using the total count method. Interobserver agreement averaged 99% across all sessions.

Social Validity

After the completion of data collection, players received an anonymous survey via e-mail with three questions related to the acceptability and feasibility of the intervention. The survey asked if the intervention was appropriate for improving pass-naming behavior, whether it should be used in future practices, and whether it helped players remember to say another player's name before passing during a game. Coaches were also interviewed about the acceptability of the intervention.

Results

Figure 1 depicts the results of the study. During baseline, the average number of named passes was 2.75 (range 2–4).

During the first intervention phase, the average increased to 54.5 (range 52–64), and the team was able to subtract two to three daily sprints from the required five. During the reversal phase, the average number of named passes reduced to 4.25 (range 4–6). During the second intervention phase, the average number of named passes was 72 (range 71–73), so the players subtracted three sprints, running a total of two for each practice.

Table 1 depicts results of the social acceptability survey. All 12 players agreed or strongly agreed that the intervention was appropriate for the targeted behavior. Seven players agreed or strongly agreed the strategy should be used in future practices, and five players disagreed. Nine players agreed or strongly agreed that the intervention helped them remember to name passes during games, whereas three disagreed. Coaches stated during the interview that the intervention was effective and appropriate.

Discussion

This study represents the first application of behavior analysis techniques to the sport of lacrosse and the first application of the PDC to identify an intervention in sports. The results of this study demonstrated that intermittent prompting plus an

Fig. 1 Number of names on passes per 100 passes during scrimmage. Each data point represents the number of passes where a player said the name of person to receive the ball in 100 opportunities during each practice scrimmage

Table 1 Results From the Social Acceptability Survey

Statement	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
The intervention is appropriate for the behavior.	6	6	0	0	0
The intervention should continue to be used in future practices.	2	5	0	5	0
The intervention helped me remember to put names to passes during games.	4	5	0	3	0

interdependent group negative reinforcement contingency—reduction of required daily sprints contingent upon increasing named passes—improved the desired behavior of saying an intended receiver's name while throwing passes during lacrosse scrimmages. During intervention phases, when coaches informed players they could reduce required sprints by one sprint per 20 named passes, the team averages improved to 52 and 73 named passes, compared to only 2 and 6 named passes in baseline phases. Our results, although preliminary, indicate the possibility that the removal of required sprints in an interdependent group format represented an effective negative reinforcement strategy, whereby the athletes increased pass naming to avoid required sprints. Furthermore, this study provides evidence that the PDC may be useful for selecting appropriate interventions in sports.

The results of the anonymous social acceptability survey showed that all players found the intervention acceptable, and most rated it as helpful for improving their pass naming during games. However, nearly half indicated disagreement that the intervention should be used in the future. This is an interesting finding that suggests potential areas for further study. First, requiring sprints constitutes a potentially aversive condition—one that was arranged specifically during intervention—to study the effects of the (later) contingent removal of sprints. Future areas of research may investigate the relative effects of required sprints, as well as a parametric analysis of the criterion level to reduce sprints, contingent upon desired performance. Second, although the researchers and coaches determined that five required sprints composed a reasonable expectation, players may have demonstrated reactivity to the intervention. Players were informed of the change to the standard practice routine and possibly rated the intervention lower because of perceived coercion vis-à-vis added sprints (Sidman, 2000). Some options for mitigating this problem in the future include requiring sprints throughout the season rather than just for a particular study or removing a different required component of practice that is standard for the lacrosse team contingent upon desired performance. Future research may seek to expand on findings related to negative versus positive reinforcement approaches in athletics.

Anecdotally, during the intervention phases, players on and off of the field yelled reminders to each other to name passes substantially more often than they did during baseline. This

suggests that the interdependent group negative reinforcement contingency created social pressure to name passes. It is possible that the prompts by coaches were not necessary because of the increased reminders from players. Because the prompting was combined with the interdependent group contingency, it is unknown if the contingency alone would have yielded similar results.

A few limitations of the present investigation exist that specifically relate to implementation of research in a demanding, fast-paced game like lacrosse. First, playing time was unequal across players, so some had the opportunity to say names more often during practice than others. Variations in player time occurred, in part due to coaches substituting players to allow breaks or to avoid injuries. Performance during play also resulted in coaches calling players on or off the field. The researchers attempted to mitigate this concern by using team performance measures. A second limitation was that recording of individual players' performance was not possible for this study. Discriminating between individual pass naming was not possible on the field without impeding play. Although pass naming was audible from off the field, the movement of players and lack of advanced recording equipment made detection of individual players' voices difficult to distinguish. A third concern was that data were not systematically collected on receptions by player, as a measure of whether the practice of pass naming corresponded with increased receptions. During the game of lacrosse, multiple passes can occur in only a few seconds, making accurate data collection difficult without the use of advanced video techniques. In addition, players at this level rarely drop passes. Naming passes primarily serves to allow the receiving player to better position herself during the catch to make her next move. Therefore, a better measure of the impact of the intervention would be player positioning during the catch rather than percentage caught. Future investigations may incorporate video equipment to improve audio and visual tracking of players on the field. Last, although the researcher was present to ensure that sprints were implemented during intervention, no formal treatment integrity data were collected.

Another potential limitation of this study was that the lead researcher was a member of the team, although she did not play in the same position as those who participated in the study. The players may have felt more inclined to comply with

the intervention due to reactivity because one of their teammates served as the primary researcher. Although ratings of social acceptability showed positive responses to the treatment, over 40% indicated the intervention should not continue.

In our preliminary investigation, the intervention showed improvements in pass-naming responses, as well as a return to baseline levels of pass-naming responses in the absence of the interdependent group negative reinforcement contingency; however, effects were only scored during practice scrimmages. Ideally, the players would generalize pass naming to games and demonstrate maintenance of the response in the absence of an intervention. Future investigations should include data collection during games and incorporate methods for unobtrusively prompting players to name passes. Last, future researchers may consider further evaluating the use of the PDC to select interventions to improve team performance.

Compliance with Ethical Standards

Conflict of Interest The first author was a player on the team at the time of the study. She played defense and the participants played offense. The second and third authors declare no conflict of interest.

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

Informed Consent Site approval was obtained from the coaches. The IRB did not require individual informed consent because the behaviors and procedures included were common in everyday lacrosse practice and data and the intervention were at the group level.

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