

REVIEW OF SPORTS PERFORMANCE RESEARCH WITH YOUTH,
COLLEGIATE, AND ELITE ATHLETES

JAMES K. LUISELLI AND KATHRYN E. WOODS

MAY INSTITUTE

AND

DEREK D. REED

UNIVERSITY OF KANSAS

This brief review summarizes translational and intervention research in the area of sports performance. We describe studies with youth, collegiate, and elite athletes; identify recent trends; and propose recommendations for future research.

Key words: applied behavior analysis, athletic skills, sports performance

Behavior analysts have studied sports performance for over three decades (Martin & Tkachuk, 2000), including applications with youth, collegiate, and elite athletes participating in baseball (Osborne, Rudrud, & Zezoney, 1990), basketball (Kladopoulos & McComas, 2001), figure skating (Ming & Martin, 1996), football (Ward & Carnes, 2002), ice hockey (Rogerson & Hrycaiko, 2002), soccer (Brobst & Ward, 2002), swimming (Hume & Crossman, 1992), and tennis (Allison & Ayllon, 1980). This research has focused primarily on interventions that were implemented directly with performers and through consultation with coaches and trainers. Interest in behavioral sport psychology has grown (Luiselli & Reed, 2011; Martin, 2011), producing refined methods and an expanded research focus. Behavior analysts continue to examine the merits of applying basic learning principles to evaluate and predict competitive sports outcomes. Our purpose in this review is to highlight (a) the types of sports performance research published in the *Journal of Applied Behavior Analysis* during the past 5 years, (b) the implications of these research

findings for sports performance professionals, and (c) the increase in translational approaches to the athletic arena.

Recent intervention studies designed to enhance athletic performance have targeted previously researched sports (e.g., football) as well as relatively new ones such as rugby and gymnastics. In research with high school football players, Stokes, Luiselli, and Reed (2010) developed a 10-step task analysis of tackling skills based on recommendations by the American Football Coaches Association (1995). During practice sessions, coach- and teammate-delivered positive reinforcement (praise and helmet stickers) increased correct execution of tackling skills by two linebackers. Similarly, Stokes, Luiselli, Reed, and Fleming (2010) increased offensive line blocking proficiency of high school football athletes when the coach implemented descriptive feedback (praise and correction) combined with video feedback (viewing practice videotapes) and performance feedback provided by an audible stimulus (teaching with acoustical guidance [TAG]; Pryor, 1999). Both studies by Stokes and colleagues found that the skills practiced and acquired during intervention were displayed successfully in games.

Also studying football, Smith and Ward (2006) reported that three intervention procedures improved wide receiver skills (blocks,

Correspondence concerning this article should be addressed to James K. Luiselli, May Institute, 41 Pacella Park Drive, Randolph, Massachusetts 02368 (e-mail: jluiselli@mayinstitute.org).

doi: 10.1901/jaba.2011.44-999

routes, releases) of collegiate players: (a) public posting plus verbal feedback: display of a daily performance chart with praise and error correction from the coach; (b) goal setting plus verbal feedback: players set a minimum of 90% correct performance criterion before practice with praise and error correction from the coach; and (c) public posting plus verbal feedback plus goal setting: reintroduction of the daily performance chart with the two previous intervention procedures. Notably, the coaches and players rated public posting plus verbal feedback plus goal setting as the most preferred combination. In a related example, Mellalieu, Hanton, and O'Brien (2006) found that goal setting in the form of a three-stage intervention enhanced multiple skills of college rugby players over an entire competitive season. Each player selected a performance improvement objective, scored performance according to a goal-attainment scaling formula, and reviewed performance outcomes with the researchers 48 hr before each match.

Finally, Boyer, Miltenberger, Batsche, and Fogel (2009) instructed young, competitive female gymnasts to watch video modeling of an expert gymnast perform skills, followed by their own performance of the same skills, concluding with freeze-framed and side-by-side video clips of both performers at five different points. The video modeling by experts with corresponding feedback improved skill performance more quickly than regular practice and coaching alone.

In both earlier and more recent intervention studies, coaches were integrally involved in defining target behaviors, collecting data, and implementing procedures. Specific coaching behaviors addressed proper technique to prevent potential injuries and preparing athletes for successful game play and individual competitions. Regarding social validation, coaches and athletes rated the methods employed in these studies favorably (Stokes, Luiselli, Reed, et al., 2010; Mellalieu et al., 2006). Going forward, behavior analysts who concentrate on sports

performance research should continue to assess strategies for assessing and promoting generalization. For example, does intervention for some athletic skills produce similar effects on nontargeted skills? Also, it is critically important that skills acquired during practice are displayed fluently during competition (Martin, Vause, & Schwartzman, 2005). Concerning maintenance, the skills learned through intervention may diminish over time (Stokes, Luiselli, Reed, et al., 2010), indicating the need for follow-up or booster training.

In translational approaches to behavioral research, behavior analysts are interested in demonstrating the generalizability of nonhuman studies on basic behavioral processes to everyday human events (see Mace & Critchfield, 2010). This has been the case with recent sports performance research, due to the clear quantification of responses and reinforcers (e.g., two- and three-point shot attempts and points made in basketball) and the wide availability of such data on sports Web sites (see Reed, 2011). In a seminal example of the applicability of behavioral processes to sports performance, Vollmer and Bourret (2000) demonstrated that the matching law (i.e., relative rates of behavior match relative rates of reinforcement) could explain and predict college basketball players' field goal shot selections. Subsequently, Romanowich, Bourret, and Vollmer (2007) replicated these findings in professional basketball. In a recent extension of these findings, Alferink, Critchfield, Hitt, and Higgins (2009) demonstrated that basketball players' degree of conformance to the matching law varied as a function of skill or ability.

In a similar series of analyses, Reed, Critchfield, and Martens (2006) suggested that offensive play selection (passing and rushing) across various levels (e.g., college, professional, etc.) of American-rules football could be explained and accurately predicted via the matching law. In these analyses, Reed and colleagues found that play-calling patterns varied systematically as a

function of down (i.e., there was a relative bias for passing on third down) and turnover risk (i.e., there was a relative bias for passing as fumble risks increased). In a subsequent study, Stilling and Critchfield (2010) more thoroughly examined the role of situation-specific variables on offensive play calling in football, demonstrating that the matching law provides both an accurate and operant explanation of play-calling strategies across situation-specific variables (e.g., time left in the half, yards needed for a first down, distance from the goal line, score, and down).

Beyond the matching law, sports performance has served as a translational conduit to understanding the role of behavioral momentum in natural settings (see Roane, 2011). For example, Mace, Lalli, Shea, and Nevin (1992) and Roane, Kelley, Trosclair, and Hauer (2004) demonstrated that college basketball teams' resistance to adversity increased as a function of relatively higher reinforcement rates. These researchers also documented that a strategic use of time-outs could disrupt opponents' rates of reinforcement, providing an applied example of how the principles of behavioral momentum could be adapted to improve coaching success. Such translational studies of sports are important to understanding the operant relations associated with game play and performance, but also speak to the explanatory flexibility of behavioral models to describe and predict behavior-reinforcement relations in both laboratory and natural environments.

The studies we reviewed illustrate the current status of sports performance research in applied behavior analysis. As for intervention, positive reinforcement, goal setting, modeling, and graphic feedback have been effective with athletes of all ages, at different skill levels, and in many sports. Other methods, like TAG, appear to be promising but require further evaluation. The tone set by prior research in assessing the acceptability of and satisfaction with sports performance intervention objectives and procedures also should be emphasized. We suggest further that applied behavior-analytic research

should compare different intervention procedures, targeting both early skill development in youth athletes and refinement of skills among proficient performers. Although the small body of translational research has concentrated primarily on quantitative analyses of collegiate and elite basketball and football players, there are certainly extensions possible to other sports, as well as further development of quantitative models derived from behavioral momentum and the matching law (Reed, 2011). On a practical level, this line of research should alert athletes and coaches to the benefits of analyzing statistics that are tied directly to performance, decision making (e.g., situational play calling), and competition strategy. Finally, following a functional analysis that manipulated coach and peer social consequences during attention and escape conditions, Stokes and Luiselli (2010) implemented a delayed, written performance feedback intervention that improved tackling skills of a high school football player. Functional analysis methodology, in fact, may be valuable in formulating athlete-specific intervention and training plans that can be adopted by coaches for a variety of individual and team sports.

REFERENCES

- Alferink, L. A., Critchfield, T. S., Hitt, J. L., & Higgins, W. J. (2009). Generality of the matching law as a descriptor of shot selection in basketball. *Journal of Applied Behavior Analysis, 42*, 595–608.
- Allison, M. G., & Ayllon, T. (1980). Behavioral coaching in the development of skills in football, gymnastics, and tennis. *Journal of Applied Behavior Analysis, 13*, 297–314.
- American Football Coaches Association. (1995). *Football coaching strategies*. Champaign, IL: Human Kinetics.
- Boyer, E., Miltenberger, R. G., Batsche, C., & Fogel, V. (2009). Video modeling by experts with video feedback to enhance gymnastics skills. *Journal of Applied Behavior Analysis, 42*, 855–860.
- Brobst, B., & Ward, P. (2002). Effects of public posting, goal setting, and oral feedback on the skills of female soccer players. *Journal of Applied Behavior Analysis, 35*, 247–257.
- Hume, K. M., & Crossman, J. (1992). Musical reinforcement of practice behaviors among competitive swimmers. *Journal of Applied Behavior Analysis, 25*, 665–670.

- Kladopoulos, C. N., & McComas, J. J. (2001). The effects of form training on foul-shooting performance in members of a women's college basketball team. *Journal of Applied Behavior Analysis, 34*, 329–332.
- Luiselli, J. K. & Reed, D. D. (Eds.). (2011). *Behavioral sport psychology: Evidence-based approaches to performance enhancement*. New York: Springer.
- Mace, F. C., & Critchfield, T. S. (2010). Translational research in behavior analysis: Historical traditions and imperative for the future. *Journal of the Experimental Analysis of Behavior, 93*, 293–312.
- Mace, F. C., Lalli, J. S., Shea, M. C., & Nevin, J. A. (1992). Behavioral momentum in college basketball. *Journal of Applied Behavior Analysis, 25*, 657–663.
- Martin, G. L. (2011). *Applied sport psychology: Practical guidelines from behavior analysis* (4th ed.). Winnipeg, Manitoba: Sport Science Press.
- Martin, G. L., & Tkachuk, G. A. (2000). Behavioral sport psychology. In J. Austin & J. E. Carr (Eds.), *Behavioral sport psychology: Handbook of applied behavior analysis* (pp. 399–422). Reno, NV: Context Press.
- Martin, G. L., Vause, T., & Schwartzman, L. (2005). Experimental studies of psychological interventions with athletes in competitions: Why so few? *Behavior Modification, 29*, 616–641.
- Mellalieu, S. D., Hanton, S., & O'Brien, M. (2006). The effects of goal setting on rugby performance. *Journal of Applied Behavior Analysis, 39*, 257–261.
- Ming, S., & Martin, G. L. (1996). Single-subject evaluation of a self-talk package for improving figure skating performance. *The Sport Psychologist, 10*, 227–238.
- Osborne, K., Rudrud, E., & Zezoney, F. (1990). Improved curveball hitting through the enhancement of visual cues. *Journal of Applied Behavior Analysis, 23*, 371–377.
- Pryor, K. (1999). *Don't shoot the dog: The new art of teaching and training*. New York: Bantam.
- Reed, D. D. (2011). Quantitative analyses of sports. In J. K. Luiselli & D. D. Reed (Eds.), *Behavioral sport psychology: Evidence-based approaches to performance enhancement* (pp. 43–59). New York: Springer.
- Reed, D. D., Critchfield, T. S., & Martens, B. K. (2006). The generalized matching law in elite sport competition: Football play calling as operant choice. *Journal of Applied Behavior Analysis, 39*, 281–297.
- Roane, H. S. (2011). Behavioral momentum. In J. K. Luiselli & D. D. Reed (Eds.), *Behavioral sport psychology: Evidence-based approaches to performance enhancement* (pp. 143–155). New York: Springer.
- Roane, H. S., Kelley, M. E., Trosclair, N. M., & Hauer, L. S. (2004). Behavioral momentum in sports: A partial replication with women's basketball. *Journal of Applied Behavior Analysis, 37*, 385–390.
- Rogerson, L. J., & Hrycaiko, D. W. (2002). Enhancing competitive performance of ice hockey goal tenders using centering and self-talk. *Journal of Applied Sport Psychology, 14*, 14–26.
- Romanowich, P., Bourret, J., & Vollmer, T. R. (2007). Further analysis of the matching law to describe two- and three-point shot selection by professional basketball players. *Journal of Applied Behavior Analysis, 40*, 311–315.
- Smith, S. L., & Ward, P. (2006). Behavioral interventions to improve performance in collegiate football. *Journal of Applied Behavior Analysis, 39*, 385–391.
- Stilling, S. T., & Critchfield, T. S. (2010). The matching relation and situation specific bias modulation in professional football play selection. *Journal of the Experimental Analysis of Behavior, 93*, 435–452.
- Stokes, J. V., & Luiselli, J. K. (2010). Functional analysis and behavioral coaching intervention to improve tackling skills of a high school football athlete. *Journal of Clinical Sport Psychology, 4*, 150–157.
- Stokes, J. V., Luiselli, J. K., & Reed, D. D. (2010). A behavioral intervention for teaching tackling skills to high school football athletes. *Journal of Applied Behavior Analysis, 43*, 509–512.
- Stokes, J. V., Luiselli, J. K., Reed, D. D., & Fleming, R. K. (2010). Behavioral coaching to improve offensive line pass blocking skills of high school football athletes. *Journal of Applied Behavior Analysis, 43*, 463–472.
- Vollmer, T. R., & Bourret, J. (2000). An application of the matching law to evaluate the allocation of two- and three-point shots by college basketball players. *Journal of Applied Behavior Analysis, 33*, 137–150.
- Ward, P., & Carnes, M. (2002). Effects of posting self-set goals on collegiate football players' skill execution during practice and games. *Journal of Applied Behavior Analysis, 35*, 1–12.

Received March 29, 2011

Final acceptance May 19, 2011

Action Editor, Dorothea C. Lerman