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ABSTRACT
This symposium presents research on recognition, prediction, and decision making in sport from researchers in applied cognitive science, human factors, instructional design, and sport psychology. Papers focus on key theoretical and practical issues related to advancing the science and training of decision-making in complex and naturalistic environments.

Program Track
Judgment and Decision Making

Areas Addressed by Proposal
Decision Making, Expertise, Learning and Training, Planning and Prediction, Situation Assessment.

Keywords
Decision Making, Expertise, Option Generation, Recognition, Prediction, Training.

1. GENERAL SUMMARY
Research on perceptual-cognitive skill and its development in sport has a relatively long history (for a review, see Ward et al., 2008). Over 50 years ago, researchers developed and implemented instructional and technological methods to train athletes to 'read the game' and make effective decisions (e.g., Damron, 1955; Haskins, 1965; Londerlee, 1967). In the ensuing decades, inspired by the seminal research by Chase and Simon (1973), there was a resurgence of sports research using representative and naturalistic tasks to examine perceptual-cognitive skills, such as recognition, anticipation and decision making (e.g., Allard, & Starkes, 1980; Abernethy, 1987). Consistent with research from naturalistic decision-making these perceptual-cognitive skills have been shown to consistently and reliably predict skilled performance in sport (see Williams & Ward, 2007).

Although the research on perceptual-cognitive skills and training in sport has thrived over the last quarter century, quite remarkably, it has progressed independently of similar progress made by human factors specialists, and more specifically by those embracing the naturalistic decision making (NDM) perspective. That is, until recently. Over the past decade, researchers have begun to straddle the divide between the worlds of sport and naturalistic decision-making. As examples, two special issues (Fiore & Salas, 2006, 2008) and a symposium at NDM 2006 related to individual and team expert decision making—initiated by a collaborative group of expertise researchers based in Florida (i.e., Florida Alliance for the Study of Expertise; <http://www.ihmc.us/research/projects/FASE/>)—encouraged cross-talk between the respective fields. Fortunately, more researchers from both fields have since begun to examine complementary issues and adopt common frameworks that will be mutually beneficial to the study of NDM.

In this symposium, a series of papers are presented on recognition, prediction and decision making in sport from researchers in sport psychology, applied cognitive science, human factors, and instructional design. A concerted effort has been made to bring together scientists, ethnographers and technologists from diverse backgrounds that conduct research that falls under the purview of NDM. In their presentations, these authors focus on key theoretical and practical issues related to advancing the science and training of decision-making in sport, and in complex and naturalistic environments more broadly.

Ward uses a prediction and situational option generation paradigm to test claims from the Recognition-primed Decision (RPD) and similar heuristic-based models. Using a representative soccer task, he shows that skilled soccer players accurately anticipate the outcome of a situation by generating relatively few situational options. However, contrary to recognition-based explanations of expertise, his data demonstrate a positive relationship between the number of options generated and decision quality when generating situational options.

Gabbard and Wattamaniuk examine a perceptual phenomenon—the flash lag effect—as a potential source of systematic error in referee offside decision making in soccer. In a laboratory-based task, they compare the ability of soccer referees and non-referees to judge the relative position of two dynamic stimuli. Their results showed that referees made more veridical judgments about the stimuli than non-referees who experienced greater disparity between stimuli than was actually present.

Macquet used the RPD model as a framework for analyzing the decisions in which volleyball players engaged during a championship match. After the match, she conducted self-confrontation interviews and asked volleyball players to comment on their game-related decision-making. Her data suggest that athletes continued to assess the situation until they were required to act, which allowed them to adapt their decision as the situation developed.

Araújo proposed an ecological approach to examining decision making in team sports using representative design. He describes the dynamics of the environment-athlete system using motion analysis data and provides a formal analysis of the dynamics of the decisional process. These data demonstrate how collective variables that evolve over time reflect the adaptive nature of behavioral decisions.

Veinott and Mueller performed an analysis of the decisiveness of quarterbacks in the National Football League based on the time spent in the pocket. Their data indicate a fundamental tradeoff between fast, sure plays with low yardage gains and slow, unsure plays with high yardage gains. The data suggest that to exploit the available opportunities quarterbacks need to balance the risks and benefits of waiting to decide rather than take the first available option.

In the last paper, Fadde describes the expert-novice research that locates recognition skills as the seat of expert advantage in ballistic sport skills, such as baseball batting and return of serve in tennis. He then demonstrates how the findings from this research, when combined with insights from RPD that support recognition training, can be applied to train recognition skills in sport.

2. SYMPOSIUM PRESENTATIONS

2.1 Prediction and Situational Option Generation in Soccer

Paul Ward, Michigan Technological University

Naturalistic models of decision making, such as the Recognition-Primed Decision (RPD) model (e.g., Klein, Calderwood, & Clinton-Cirocco, 1986; Klein, 1997), suggest that as individuals become more experienced within a domain they automatically recognize situational patterns as familiar which, in turn, activates an associated situational response. Typically, this results in a workable course of action being generated first, and subsequent options generated only if the initial option proves ineffective.

Supporting these claims, Klein, Wolf, Militello, and Zsambok (1995) reported that when high and medium skilled chess players engaged in a move selection and option generation task, they considered acceptable moves first, and generated a small number of the possible legal moves only. Testing a similar, albeit fast-and-frugal claim that recognition of fewer, rather than more, options results in better judgments (see Goldstein & Gigerenzer, 2002), Johnson and Raab, (2003; Raab & Johnson, 2007) demonstrated that superior and expert handball players generated two to three courses of action and chose their first option as best. In addition, the number of options generated was inversely related to the quality of decision.

An important precursor to recognizing a workable course of action is the ability to generate options about the situation itself (Klein & Peio, 1989). According to RPD, experts use perceptual cues and other knowledge to recognize situation prototypicality, and develop expectations about how the situation will unfold. Accordingly, when making predictions or generating options about the behavior of others in the environment, one might expect experts to make accurate predictions by generating few options about the situation, and the number of options to be negatively related to decision quality (e.g., de Groot, 1965; Johnson & Raab, 2003; Klein & Peio, 1989). The use of a prediction paradigm would also address Klein's (1997) call to focus on how individuals recognize the problem situation.

Three experiments were designed to test some of these hypotheses. Skilled and less skilled soccer players were tested in a simulated soccer task using a prediction and situational option generation paradigm. Participants viewed 10s video clips of live professional soccer games, from a defensive perspective, that contained offensive, dynamic, patterns of soccer play. Each clip ended unexpectedly, immediately prior to an opposing offensive player with the ball performing an action (e.g., shot at goal, pass to player X).

At the end of the clip participants anticipated the actual outcome of the situation (i.e., what the player with the ball actually does next) (prediction). In addition, participants generated the threatening options available to the opposing team then prioritized each option by ranking them from most (i.e., best) to least threatening to their defense (i.e., worst) (situational option generation). Between two and five 'good' (i.e., task-relevant) options were available on each trial, as judged by a panel of expert coaches. The actual option taken by the opposing player was judged as best. Across experiments, participants performed the tasks separately or simultaneously, and either with (i.e., last frame of the video available) or without perceptual support (i.e., from memory).

In general, skilled participants more accurately anticipated the outcome of each dynamic soccer situation than less-skilled participants. While the total number of situational options generated per trial by all participants was relatively few (i.e., 2-3), skilled participants highlighted more task-relevant options, less task-irrelevant options and more accurately prioritized task-relevant options than less skilled players. Moreover, although the number of task irrelevant options generated was negatively related to the ability to anticipate the best outcome, the number of task relevant options and the ability to prioritize them effectively, was positively related to the quality of anticipatory decision.

While the number of options generated is consistent with RPD, the positive relationship between option generation and anticipatory decision quality suggests that skilled participants may use different mechanisms to support performance. The use of a situation model may provide an alternative mechanism to explain the skilled participants' data. Ericsson and Kintsch (1995; Ericsson & Ward, 2007) proposed that with increasing skill level, experts acquire the ability to build dynamic memory representations that describe the semantic relations of the current situation. Such mechanisms facilitate encoding of predictive and other types of situational inferences and permit future retrieval demands to be accurately anticipated. The acquisition of such representations was termed long-term working memory skill. These skills have also been implicated in the development of situation awareness (Durso, Rawson, & Girotto, 2007). Future research should explore the complementarity between models of expertise in option generation during prediction, assessment, and decision-making.

2.2 Referee Offside Decisions: The Nature of Expert Decisions in Moving Position Determination and the Flash Lag Effect

Stephen R. Gabbard and Scott N. J. Watamaniuk, Wright State University

Within a 90-minute professional or national team level soccer match, a referee must make hundreds of decisions. These range from binary and unsituated perceptual decisions (e.g., in or out of bounds) to much more nuanced, two or more player interactions that require not only a view of what happened, but in some cases an interpretation of intent. For example, virtually every player-opponent interaction results in a six-alternative forced choice decision within law 12 (fouls and misconduct). Many attacks on goal result in a decision process by the referee crew and assistant referee in particular about offside (law 11). While the decision is straightforward in that there is no judgment of intensity or intent needed, it can be perceptually complex and appears to be affected by bias effects, because determination errors do not appear to be evenly distributed. This leads to a question of whether the systematic errors are cognitive or perceptual in nature – or both, and what the source could be. One possible source of systematic error recently proffered has been the application of the flash lag effect (FLE) to this judgment. The FLE is an optical illusion that occurs when an observer is presented a flashed object even (as displayed in a single frame) with a moving object and judges the moving object ahead of the flashed object.

Leading theories of the FLE, differential neural latency and postdiction (temporally weighted spatial average), posit that a moving object's perceived position lags a spatiotemporal marker by tens of ms. Baldo et al. (2002) suggested that the FLE might be operational on a soccer field as the Assistant Referee (AR) determines the position of a moving attacker relative to a defender, typically also moving. The temporal marker would be the observation, extrapolated anticipation, or sound of the ball being kicked by a teammate of the attacker, usually outside the foveal vision of the AR as s/he attends to the possibly offside attacker.

In a study designed to simulate some of the dynamics of the offside call, four soccer referees and three non-referees judged the position of a moving blue rectangle relative to a red reference rectangle (moving or stationary) at a time identified by a tone (object positions at the time of the tone were varied systematically). Trials lasted from 500 to 2000 ms and objects moved at a range of soccer-appropriate speeds. There was no fixation point and observers were free (as referees are) to pursue objects as they saw fit (no feedback was given).

Data from 30 conditions, presented randomly over several sessions, were fit with logistic functions. A 2-way repeated measures ANOVA (approach speed x participant group) showed significant main effects only (approach speed – $F(2,95) = 9.93$, $p<.0001$; participant group - $F(1,95)=13.01$, $p<.0005$). For any given tone-position condition, non-referees perceived the blue target rectangle to have moved further (more FLE) than referees (negative FLE), who were more veridical as a group. However, the effect even for non-referees was much smaller than predicted by the typical FLE, suggesting that the FLE is unlikely to be operating on the soccer field. However, even the small position error observed would produce a robust offside call bias in soccer, which may be an adaptation to compensate for the perceptual complexity of the offside call.

There were substantial individual differences among the observers. In a pilot-study with feedback, the worst performer of the main experiment improved his performance almost to the levels of the best performer. The best performer, perhaps not coincidentally, had hundreds of thousands of perceptual trials of all kinds as an experience base, but was in the non-referee group. The implication of this study in light of persistent bias is discussed along with other plausible explanations as well as the nature and limits of expertise in this domain.

2.3 Decisions Based on Recognition in Volleyball

Anne-Claire Macquet, Institut National du Sport, France

In sports, athletes must make efficient decisions in a short time frame. Time constraints present a conflict: athletes must act quickly even though they need time to interpret the situation. To cope with time pressure, they have to make decisions with an incomplete understanding of the situation in order to have time to act (Amalberti, 2001). Most competitive situations in sports present similarities to dynamic situations studied using the NDM approach (e.g., Salas, & Klein, 2001). They include ill-structured problems and time pressure, and refer to an uncertain and changing environment. Within the NDM approach, Klein, Calderwood, and Clinton-Cirocco (1986), and Klein (1997) developed the Recognition Primed-Decision model (RPD) to explain experienced agents' decision-making. This model suggests that agents assess the current situation by recognizing its typicality, through four by-products: (a) expectancies, (b) relevant cues, (c) plausible goals, and (d) typical action. They then implement a course of action based on a typical action. The situation assessment has three levels: simple match, diagnosis of the situation, and evaluation of a course of action. This study aimed to assess the RPD model in an elite sport setting and characterize the significant elements taken into account by athletes during the decision-making process.

Seven male high-level volleyball players volunteered to participate in the study. Data were recorded during a French Championship match and self-confrontation interviews. In these individual interviews, each player was invited to describe and comment upon his decision-making during the action. Data were processed in three phases: (a) making short accounts of the situation, (b) identifying significant elements taken into account during the decision-making process, (c) analyzing these accounts in relation to the RPD model.

Results showed that players used 12 categories of significant elements to assess the situation: (a) actions of opponent(s), (b) team-mate(s), (c) themselves, (d) trajectory of the ball, (e) expectations about players' actions, (f) abilities and tendencies of their opponent(s), (g) team-mate(s), (h) themselves, (i) number of decision(s) made, (j) rules used, (k) preceding event, and (l) consequence of a course of action. These categories were compared to the by-products of the RPD model. Players' actions and trajectory of the ball related to relevant cues. Rules used and a preceding event related to typical actions. Expectations and players' abilities and tendencies were concerned with expectancies. The number of decisions made related to the plausible goal. These elements allowed them to assess the situation quickly or not, depending on the availability of information in relation to the development of the situation. Most often, the players simply assessed the situation quickly (81.43% of the total decisions). Sometimes they had to wait for useful information (event locus and moment) and assess a changing situation (12.86% of the total decisions). They seldom evaluated the outcome of a possible course of action to check if it could work (5.71% of the total decisions). However, when they did and their evaluation was favorable, they carried out the action; when it was not, they made another decision. The comparison between these three levels and those of the RPD model revealed consistency.

The results of the current study showed that players' decision-making was based on a process of recognition of a typical situation. Results reinforced the RPD model (Klein, 1997). Players perceived significant elements of the situation according to their roles and their functions in the team. As the model predicts, the players often simply matched the situation or analyzed it for a longer time; they continued to assess it until they carried out their action. This continuing situation assessment allowed them to adapt their decision as the situation developed. This continuing assessment related to the concept of situation awareness (Endsley, 1995).

Results showed that initially each situation presented a number of possible actions. As the situation developed, the number of possibilities decreased for each player each time, according to his situation assessment which, in turn, depended on his role in the team, his experience, and competencies. Moreover, these possibilities largely depended on the playbook that defined associations between typical situations and typical actions. Results suggest that most often, decisions were not really made by the player, meaning he did not choose between several courses of action. Decisions were rather constrained by the way the situation developed, teamwork, and the player himself (competencies, fatigue, and trust). They emerged from the player's interpretation of the situation. They lead us to think outside the box and to consider that a course of action is constrained more than chosen by experienced athletes.

2.4 The Dynamics of Decision-Making in Team Ball Sports

Duarte Araújo, Technical University of Lisbon, Portugal

Most of us would probably agree that for important decisions, we should follow certain guidelines: from gathering information to comparing options, and setting goals before getting started. But in daily life situations, we make some of our best decisions by adapting to circumstances rather than thought-out procedural steps. Behavioral decisions, such as those made by elite athletes, go beyond mental calculation and cannot be predicted as a direct result of such. Moreover, there is evidence that the actual behavioral decision process goes against what some coaches promote in their practice sessions. Indeed, the vast majority of research in sport erroneously assumes decision-making as being a result of a deliberative process (for a review see Williams & Ward, 2007). There are two reasons for this: First, researchers mainly use outcome measures such as reaction time or number of errors; Second, a major problem in studies that focus on the perceptual-cognitive side of a perceptual-motor task is that they allow for 'an analytical stance'. This stance is not representative of the perceptual-motor functioning of mechanisms underlying the selection and control of a given action in situ. The aim of this talk is to consider the decision-making process as an integral part of goal-directed behavior constrained at the scale of the environment-athlete system.

To consider behavior at an ecological scale there is a need for studying behavior in representative tasks. The criteria to develop an operational definition of "representative experimental task design" (Araújo et al., 2007):

- maintain the noisy decision tasks towards which researchers intend to generalize
- be designed in such a way that perceiving information that specifies a property of interest in the task should allow one to make reliable judgments and actions about this property (task constraints with high diagnostic value),
- include situations evolving in time and showing interrelated decisions,
- enable performers to act in the context in order to detect information to guide their actions to achieve their goals.

Although scientists aspire to carry out well-designed and controlled experiments, the tendency to design simplistic and often novel tasks, will not accomplish the need for representative tasks of a certain sport.

Competitive games are not stable contexts in which information is assured. In contrast, successful players need to adapt their actions to the dynamically shifting environment that characterizes the archetypal performance setting. To the extent that such flexibility is tailored to current environmental conditions or task demands, it implicates perceptual control. Araújo et al. (2006) argue that transitions among stable states occur as a result of dynamic instability. Dynamic instability thus provides a universal decision-making process for switching between and selection among polarized states. So, if better ways are out there to fit the circumstances and context of a given coordination pattern, fluctuations will help the system discover and explore them. This is not a switch, per se, but a qualitative change that arises due to the intrinsic nonlinearity of the pattern dynamics.

Based on an ecological dynamics approach (Araújo et al., 2006), we provide a formal analysis of the dynamics of athletes' decisional process. By measuring how players select and adapt their actions during a given task, we developed a direct assessment of the mechanisms of decisional behavior. We have used motion analysis, for describing the dynamics of a system comprised by an individual and his/her environment (e.g., movements of other players). We have data showing how collective variables such as the distance of the dyad to the goal evolve over time. With these collective variables, we formally captured the dynamic properties of the environment-athlete system in the decisional task, demonstrating the adaptive nature of behavioral decisions in representative tasks. Moreover, we developed dynamic non-linear models, both for descriptive and predictive purposes. Part of the attractiveness of dynamic models is derived from the fact that they can explain these several different decisions by means of the same underlying process of originating and decaying attractors.

2.5 Indecision in the Pocket: An Analysis of the Quarterback Decision Making Environment

Elizabeth S. Veinott & Shane T. Mueller,
Applied Research Associates, Inc.

Decisiveness is widely considered a positive trait in our society, and few roles typify the need for decisive action more than an American Football Quarterback. The quarterback's probability of successfully completing a pass decreases sharply in the first few seconds after the snap, suggesting that a quarterback needs to be able to quickly identify and execute a plan to be successful. However, as the time in the pocket increases, opportunities also emerge, allowing quarterbacks to attempt longer and more rewarding passes (albeit with a lower probability of success). Consequently, plays during which a quarterback is patient and foregoes fast small gains may in fact be more productive. If this were true, offensive systems or individual plays designed to allow for longer decision times may on average be more successful, and decisiveness may be a less attractive trait for a quarterback than patience and poise.

To investigate the costs and benefits of waiting versus acting during the moments following the snap, we examined time-in-pocket data from twenty-one National Football league games during the 2007 Season. Data were collected for the first three games of the 2007 NFL season for seven NFL teams, and were originally used in a statistical model to assess the abilities of different defensive players (Alamar & Weinstein-Gould, 2008). In the present paper, we focus on data from quarterback decision times, yardage attempted, and yardage gained (both to the point of reception and in total). Only passing plays were considered. A total of 500 plays were analyzed.

Quarterbacks made passing decisions quickly, with a median of just 2.28 seconds. Success rates for plays decreased from on average 78% for the fastest decile (roughly 1 s), to 42% for the slowest decile (averaging 3.8s). The fastest decile of plays were attempted for short yardage (an average of just 2.0 yds), whereas the slowest decile were longer (averaging 12 yds). This establishes that there is a fundamental tradeoff between fast, sure plays with low payoff and slow, unsure plays with high payoff. When we combined yardage and success rate (to compute passing performance), we found that each decile above the median time-in-pocket was more productive than every decile below the median time-in-pocket, and this held whether or not yards gained after the catch were included. Furthermore, passing performance peaks at about half a second longer than the median time in the pocket, and then slowly declines as time-in-pocket increases to a level that is still better than fast short plays.

We also examined this relationship for each of seven teams in the data set. Our results indicate that the above conclusions held for all seven teams when yards gained in the air were considered, and for six of seven teams when yards gained after the catch were included. That is, more of the yardage gained in the air (i.e., to the point of reception) happened on slower plays than faster plays, and although some teams gained more yards on the ground following fast plays than slow plays, this advantage only overcame the slow-play passing advantage for one team. Together, these results suggest that opportunities may favor quarterbacks who do not fear indecision, but rather balance the risks and benefits of waiting to decide.

Effective decisions are a key feature of good NFL quarterbacks. But their decision environment is not simply one that rewards high decisiveness. Rather, they face an environment with a natural tradeoff: wait and they gain opportunities, but reduce their success rate. Our analysis shows that on the football field, patience is rewarded with greater overall yardage gains. Interestingly, in this environment, focusing on success and error statistics may hurt a quarterback, because it will encourage him to make less risky decisions that overall are less productive. Instead, focusing on yards gained, even at the cost of completion statistics, may encourage more optimal performance overall.

Overall, our analysis shows that although indecision can be debilitating, the fear of indecision might also put an expert decision maker at a considerable disadvantage. A quarterback who is unwilling to forgo high-probability short plays for the chance of a big payoff will miss out on the most valuable opportunities, and be at a disadvantage. Similar trade-offs may exist in many other expert decision making situations, and so measures and theories that balance decisiveness with patience are needed to help better understand these decision domains.

2.6 Recognition Primed Decision-Making Training (RPD) as a Model for Training Perceptual-Cognitive Skills in Tennis and Baseball

Peter Fadde, Southern Illinois University

Although the Recognition Primed Decision-Making (RPD) model (Klein, 1998) is typically associated with a command-and-control level of decision-making, RPD also provides a rich model for training reactive psychomotor skills such as baseball batting and return-of-serve in tennis. A baseball batter typically has less than one-half second to decide if and where to direct the swing of his bat and to execute the swing. A tennis returner is faced with a similarly time constrained task. This paper describes 1) expert-novice research that locates recognition skills as the seat of expert advantage in these ballistic sport skills, 2) application of the methods as well as the findings of research to the training of recognition skills, and 3) insights from RPD that support recognition training.

A body of sports expertise research has used a video occlusion method to locate a "window" of expert advantage in a variety of high-speed sport skills including baseball batting and return-of-serve (Williams & Ward, 2003). The video occlusion method involves athletes of varying skill level (expert and novice paradigm) viewing video clips of an opponent pitcher or server that depict the internal perspective of a batter or returner. Video clips of pitches or serves are cut off (temporal occlusion) at various points in the pitching/serving motion or the resulting ball flight. Participants are required to indentify the type of pitch/serve or predict the ultimate location of the pitch/serve in the hitting zone. In baseball experts show superior performance in identifying pitch type and predicting pitch location. Specifically, the exert batters' advantage extends from the Moment-of-Release (MOR) of a pitch through about 150 milliseconds of ball flight, which represents about one-third of a pitch's flight (Paull & Glencross, 1997). In tennis researchers have found that the window of predictive advantage starts moments before contact of the server's racquet with the ball (Scott, Scott, & Howe, 1998).

A number of researchers have re-purposed the video occlusion method used to measure perceptual-cognitive skills into a training method used to improve the perceptual-cognitive skills of baseball pitch recognition (Burroughs, 1984; Fadde, 2006) and tennis serve recognition (Farrow et al, 1998). These studies have generally demonstrated transfer of trained perceptual-cognitive skills to representative performance tasks and, in at least one study, to performance of the full skill in game competition (Fadde, 2006).

The implications of part-task training of perceptual-cognitive skills such as pitch and serve recognition is that athletes are provided with a method to systematically train an elusive aspect of expert performance by applying the same focused, progressive training approaches associated with weight training and technique training. When perceptual-cognitive training is delivered on a laptop computer then self-directed training of high-level sub-skills can be pursued during travel or rehabilitation without requiring the participation of other players, coaches, or facilities.

Some sports expertise researchers argue for a direct perception model, maintaining that the perception-action link cannot be de-coupled -- for research or training purposes -- without essentially changing the task (Bootsma & Hardy, 1997). By contrast, the cognitive information-processing model that is generally embraced by sports expertise researchers provides theoretical support for the part-task training of perceptual-cognitive skills. As a serial processing model, however, CIP is challenged at the transition points between distinct cognitive processing stages. Indeed, baseball batting and tennis return-of-serve involve overlapping cognitive processes that begin with tactical reduction of choice options, continue through recognition of predictive cues, and culminate in response selection. But different players can have different responses to the same opponent action. For example, a tennis returner may read kick serve and opt for a defensive lob return of this high-bouncing serve. Another player may take advantage of an early "read" of kick serve to strike the ball on the rise before it bounces to its full height. Both returners benefit from an early read of the serve.

The Recognition-Primed Decision-Making model addresses both the stage conundrum and variation in response selection by seeing the recognition stage as priming rather than dictating the decision stage. The RPD model, then, supports measuring and training the recognition stage of highly reactive sport skills in isolation not only from the psychomotor execution stage but also from the decision (response selection) stage. The implication is that recognition skills are much more generic, and therefore trainable, than are decision skills. RPD, therefore, supports highly targeted, part-task, decision-agnostic training of recognition skills in reactive skills in sports and potentially in a wide range of performance domains.

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