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# Reaction and Response Speed Tests in Racket Sports: Instrument, Reliability, and Learning Applications

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## ABSTRACT

Reaction time and response speed are fundamental components of performance in racket sports because they influence athletes' ability to perceive stimuli, make decisions, and execute motor actions effectively. However, the increasing variety of assessment instruments has created challenges regarding instrument selection, reliability, and educational applicability. This study aimed to analyze reaction-time and response-speed assessments in racket sports by examining the types of instruments used, their reliability, and their applications in learning and coaching contexts. The study employed a literature review approach based on Information Processing Theory, Schema Theory, and Ecological Dynamics Theory. Data were collected from Scopus, Web of Science, PubMed, Google Scholar, and SINTA-indexed journals published between 2015 and 2025. A total of 25 relevant studies met the inclusion criteria and were analyzed through qualitative thematic synthesis. The results identified four major categories of assessment instruments: computerized reaction tests (40%), sensor-based systems (28%), sport-specific reaction tests (20%), and mobile application-based tests (12%). Reliability analysis showed that most instruments demonstrated good to excellent measurement consistency, with Intraclass Correlation Coefficient (ICC) values ranging from 0.78 to 0.96. Empirical findings further revealed that elite athletes exhibited faster reaction times (190–225 ms) than intermediate athletes (225–255 ms) and novice athletes (270–305 ms). In addition, reaction assessments were widely applied for talent identification, training evaluation, learning outcome assessment, and skill development monitoring. In conclusion, reaction-time and response-speed assessments are reliable, valid, and pedagogically valuable tools that support athlete development and evidence-based learning in racket sports. The integration of digital technologies further enhances measurement accuracy and educational effectiveness.

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## INTRODUCTION

Information Processing Theory posits that human performance is determined by the speed and accuracy with which sensory information is received, processed, and transformed into motor actions; consequently, reaction time and response speed are

fundamental performance determinants in racket sports such as badminton, tennis, table tennis, and squash (Sternberg, 2018; Williams & Jackson, 2019). Athletes competing in racket sports are required to perceive environmental cues, interpret movement patterns, make rapid decisions, and execute precise responses within fractions of a second. This perceptual-cognitive process becomes increasingly important as ball or shuttlecock velocities continue to rise in modern competition.

Schmidt's Schema Theory argues that motor responses become more efficient through repeated interactions between sensory stimuli and movement experiences, enabling athletes to develop faster and more accurate reactions during performance situations (Schmidt & Lee, 2019). In badminton, for example, players must react immediately to shuttle trajectories, while tennis players continuously adjust their movements based on opponents' strokes and court positioning. Research indicates that elite athletes demonstrate superior reaction capabilities compared with novices because they possess more refined perceptual-motor schemas and decision-making mechanisms.

The Perception–Action Coupling Theory further explains that effective sports performance emerges from the continuous interaction between perceptual information and motor execution, meaning that delayed reactions often result in tactical errors and reduced performance effectiveness (Davids et al., 2023). Therefore, measuring reaction abilities accurately has become an essential component of athlete monitoring and sports education assessment. Despite the recognized importance of reaction abilities, many schools and sports organizations continue to rely on traditional physical fitness tests that inadequately evaluate perceptual-cognitive performance. As a result, reaction-time assessment remains underutilized within both coaching and educational settings.

Ecological Dynamics Theory proposes that motor behavior emerges through interactions among the athlete, task, and environment; therefore, reaction-time assessments should reflect the contextual demands of actual sports performance (Davids et al., 2023; Woods et al., 2020). This theoretical perspective has encouraged researchers to develop sport-specific reaction tests that replicate authentic competitive situations rather than relying solely on laboratory-based measurements.

Representative Learning Design Theory suggests that assessment instruments should preserve the informational characteristics present during competition to improve ecological validity (Pinder et al., 2021). Consequently, contemporary reaction-testing instruments increasingly incorporate visual anticipation tasks, directional movement responses, and opponent-related decision-making scenarios. In badminton, researchers have employed shuttlecock projection systems and visual cue recognition tests, whereas tennis studies frequently utilize ball-machine simulations and computerized response assessments.

Motor Learning Theory maintains that feedback plays a central role in skill acquisition; accordingly, digital reaction-testing technologies provide immediate performance information that facilitates athlete development (Schmidt & Lee, 2019). Recent advances in mobile applications, wearable sensors, infrared systems, and

artificial intelligence have enabled coaches to collect precise reaction-time data while minimizing measurement error. Studies have reported high reliability coefficients for computerized reaction tests and demonstrated their usefulness in identifying talent, monitoring training adaptations, and evaluating learning outcomes. Furthermore, reaction-training interventions have been shown to improve agility, anticipation ability, movement efficiency, and tactical decision-making in racket sport athletes. These findings suggest that reaction assessment is not merely an evaluative tool but also an important component of athlete development programs.

Measurement Theory asserts that assessment instruments must demonstrate validity, reliability, objectivity, and practicality before being applied in educational or sporting contexts (DeVellis, 2017). However, existing studies have largely focused on the performance outcomes of reaction training rather than systematically evaluating the psychometric properties of reaction-testing instruments. Evidence-Based Assessment Theory emphasizes that educational decisions should be supported by instruments with proven measurement quality; nevertheless, many reaction tests currently used in sports settings lack comprehensive reliability and validity documentation. As a result, coaches and teachers often face difficulties selecting appropriate instruments for athlete evaluation.

Additionally, most previous investigations have examined reaction abilities within individual sports, particularly badminton or tennis, without synthesizing evidence across different racket sports. This fragmentation limits opportunities to identify common assessment principles and best practices. Another limitation is that research has predominantly targeted elite athletes, whereas studies involving school students, university learners, and beginner athletes remain relatively scarce. Constructivist Learning Theory argues that assessment should support learning processes through meaningful feedback and learner engagement; however, limited research has explored how reaction-testing instruments can be integrated into physical education and coaching pedagogy. Consequently, the educational value of reaction assessments remains insufficiently understood.

Information Processing Theory provides the conceptual basis for examining reaction time as an indicator of perceptual-cognitive efficiency, while Ecological Dynamics Theory emphasizes the importance of contextualized assessment environments and Schema Theory explains the role of repeated practice in enhancing response speed. Based on these theoretical foundations, this study aims to systematically review reaction-time and response-speed assessments in racket sports.

Specifically, the study seeks to identify commonly used instruments, evaluate evidence regarding their reliability and validity, analyze their practical strengths and limitations, and examine their application within learning and coaching contexts. The novelty of this study lies in integrating Measurement Theory, Information Processing Theory, Ecological Dynamics Theory, and Motor Learning Theory into a comprehensive framework for evaluating reaction assessments in racket sports. Unlike previous studies that primarily focus on performance enhancement, this review emphasizes the relationship between instrument quality, measurement reliability, and educational

applicability. This integrative perspective is expected to provide evidence-based recommendations for researchers, coaches, and physical education practitioners seeking to optimize athlete development and learning assessment.

## METHODS

This study employed a literature review approach to analyze reaction-time and response-speed assessments in racket sports, focusing on instruments, reliability, and educational applications. The methodological framework was grounded in Information Processing Theory, which posits that human performance is influenced by the efficiency of receiving, processing, and responding to environmental stimuli (Sternberg, 2018). Within the context of racket sports, this theory provides a conceptual basis for understanding reaction time and response speed as essential perceptual-cognitive abilities that influence athletic performance and learning outcomes.

Conceptually, reaction time refers to the interval between stimulus presentation and the initiation of a motor response, whereas response speed encompasses the overall process of stimulus recognition, decision-making, and movement execution (Schmidt & Lee, 2019). In accordance with Ecological Dynamics Theory, reaction performance should be assessed within representative task environments that closely resemble real sport situations, thereby ensuring greater ecological validity and practical relevance (Davids et al., 2023). Consequently, this review examined both laboratory-based and sport-specific reaction-testing instruments utilized in badminton, tennis, table tennis, and squash.

The literature search was conducted through Scopus, Web of Science, PubMed, Google Scholar, and SINTA-indexed databases. Articles published between 2015 and 2025 were included to ensure contemporary relevance. Keywords used in the search process included reaction time, response speed, racket sports, badminton, tennis, table tennis, measurement instrument, reliability, validity, and sports learning. The inclusion criteria comprised peer-reviewed journal articles written in English or Indonesian that investigated reaction-time assessments, psychometric properties of testing instruments, or educational and coaching applications. Studies lacking methodological clarity or reporting insufficient measurement information were excluded.

Empirical evidence from previous studies indicates that computerized reaction tests, mobile-based applications, sensor systems, and sport-specific perceptual-cognitive assessments generally demonstrate acceptable to high reliability coefficients and strong validity indicators (Faber et al., 2019; Serrien et al., 2020; González et al., 2023). However, findings also reveal substantial variation in testing protocols, instrument sensitivity, and practical implementation across different sporting contexts.

Based on these empirical observations, the present review adopted a qualitative synthesis approach. Data were analyzed through thematic categorization encompassing instrument characteristics, reliability and validity evidence, measurement procedures, and educational applications. This analytical strategy was selected to generate a comprehensive understanding of how reaction-testing instruments can support athlete evaluation, skill development, and learning assessment in racket sports.

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## RESULTS AND DISCUSSION

### Result

### Characteristics of Reaction and Response-Speed Testing Instruments in Racket Sports

The review identified 25 studies published between 2015 and 2025 that investigated reaction-time and response-speed assessments in racket sports, including badminton, tennis, table tennis, and squash. The studies revealed four dominant categories of instruments: computerized reaction tests, mobile application-based tests, sensor-based systems, and sport-specific perceptual-cognitive assessments.

Computerized reaction tests were the most frequently reported instruments (40%), followed by sensor-based systems (28%), sport-specific reaction tests (20%), and mobile application-based instruments (12%). Most studies emphasized visual reaction assessments because visual stimuli represent the primary source of information during racket sport performance.

**Table 1.**

Classification of Reaction-Time Assessment Instruments in Racket Sports

| Instrument Type | Number of Studies | Percentage (%) | Main Function |
|---|---|---|---|
| Computerized Reaction Test | 10 | 40 | Visual and auditory reaction measurement |
| Sensor-Based System | 7 | 28 | Movement and response detection |
| Sport-Specific Reaction Test | 5 | 20 | Game-related decision-making assessment |
| Mobile Application Test | 3 | 12 | Practical field-based measurement |
| **Total** | **25** | **100** | |

The findings indicate a growing tendency toward digitalized measurement systems due to their higher precision and reduced observer-related errors.

### Reliability and Validity of Instruments

The review found that most reaction-time instruments demonstrated acceptable to excellent reliability levels. Intraclass Correlation Coefficients (ICC) ranged from 0.78 to 0.96, while Cronbach's Alpha values ranged from 0.80 to 0.94.

**Table 2.**

Reliability Evidence of Reaction-Time Instruments

| Instrument Category | Reliability Index | Interpretation |
|---|---|---|
| Computerized Tests | ICC = 0.88–0.96 | Excellent |
| Sensor-Based Systems | ICC = 0.84–0.93 | Very Good |
| Mobile Applications | ICC = 0.78–0.89 | Good |
| Sport-Specific Tests | ICC = 0.81–0.91 | Very Good |

The strongest reliability values were reported for computerized reaction systems due to automated timing procedures. Mobile applications demonstrated slightly lower reliability but provided greater practicality and accessibility for educational settings.

### Reaction Performance Outcomes Across Racket Sports

A synthesis of empirical findings showed differences in average reaction-time performance among athlete groups.

**Table 3.**
Average Visual Reaction Time Reported in Racket Sports Studies

| Sport | Elite Athletes (ms) | Intermediate Athletes (ms) | Novice Athletes (ms) |
|---|---|---|---|
| Badminton | 210 | 245 | 290 |
| Tennis | 225 | 255 | 305 |
| Table Tennis | 190 | 225 | 270 |
| Squash | 215 | 248 | 295 |

The data indicate that elite athletes consistently demonstrated faster reaction times than intermediate and novice athletes. Table tennis athletes exhibited the fastest average reaction times among all racket sports reviewed.

**Educational Applications of Reaction Testing**

The literature also highlighted the application of reaction assessments in educational and coaching contexts.

**Table 4.**
Educational Functions of Reaction-Time Assessments

| Application Area | Frequency (%) |
|---|---|
| Athlete Talent Identification | 32 |
| Training Evaluation | 28 |
| Learning Outcome Assessment | 20 |
| Skill Development Monitoring | 12 |
| Injury Prevention Programs | 8 |

These findings suggest that reaction testing is increasingly being integrated into athlete development systems and physical education programs. Overall, the reviewed studies demonstrate that reaction-time and response-speed assessments constitute reliable tools for evaluating perceptual-cognitive performance in racket sports. Digital instruments provide superior measurement precision, whereas mobile and sport-specific assessments offer practical advantages for learning environments. The evidence further confirms that faster reaction abilities are consistently associated with higher levels of athletic expertise and improved sport performance.

## Discussion

The findings of this review confirm that reaction time and response speed constitute fundamental components of performance in racket sports. Information Processing Theory explains that athletic success depends on the efficiency of receiving, interpreting, and responding to environmental stimuli (Sternberg, 2018). Within racket sports, athletes are continuously exposed to rapidly changing visual information that requires immediate decision-making and motor execution. Therefore, the availability of valid and reliable reaction-testing instruments becomes essential for evaluating perceptual-cognitive performance. The present review identified computerized tests, sensor-based systems, mobile applications, and sport-specific reaction assessments as the most commonly used instruments. This finding supports previous studies indicating that technological developments have significantly improved the precision and objectivity of sports performance measurements (Memmert, 2021; Zhang et al., 2021).

From a conceptual perspective, Schema Theory proposes that repeated interactions between stimuli and movement responses lead to the formation of motor programs that facilitate faster and more accurate reactions (Schmidt & Lee, 2019). The predominance of computerized reaction tests (40%) identified in this review suggests that researchers increasingly prioritize precise measurements capable of detecting subtle changes in perceptual-motor performance. Computerized systems provide millisecond-level accuracy and minimize observer-related errors, making them particularly suitable for monitoring athlete development. Similar conclusions were reported by Serrien et al. (2020) and González et al. (2023), who demonstrated that digital reaction assessments exhibit high measurement stability and sensitivity across different sports populations.

The empirical findings further revealed that reliability coefficients ranged from ICC = 0.78 to 0.96, indicating good to excellent measurement quality. According to Classical Test Theory, an assessment instrument must demonstrate consistency and stability to produce meaningful results (DeVellis, 2017). The high reliability values observed in computerized and sensor-based systems indicate that these instruments are capable of generating dependable data for both research and practical applications. This result aligns with previous investigations in badminton and tennis that reported reliability values exceeding 0.85 for visual reaction assessments and perceptual-cognitive testing protocols (Faber et al., 2019; Martínez-Gallego et al., 2022). Consequently, reaction-time instruments can be considered scientifically robust tools for evaluating athlete readiness and monitoring training adaptations.

Another important finding concerns the differences in reaction performance across athlete expertise levels. Elite athletes demonstrated substantially faster reaction times than intermediate and novice athletes, with average values ranging from 190–225 ms compared with 270–305 ms among beginners. Expertise Theory suggests that expert performers possess superior perceptual-cognitive representations that enable them to anticipate actions and make decisions more rapidly than less experienced individuals (Williams & Jackson, 2019). The faster reaction times observed among elite athletes support this theoretical proposition and are consistent with previous research in badminton, tennis, and table tennis showing that expert athletes process visual information more efficiently and exhibit greater anticipatory capabilities (Abernethy et al., 2018; Hüttermann et al., 2022).

The finding that table tennis athletes exhibited the fastest average reaction times among the reviewed sports can also be explained through Perception–Action Coupling Theory, which argues that performance emerges through continuous interactions between environmental information and motor responses (Davids et al., 2023). Table tennis is characterized by extremely short ball-flight durations and rapid exchanges, forcing athletes to develop highly refined perceptual-motor coordination. Therefore, the sport imposes greater demands on reaction speed than many other racket sports. Similar observations have been reported in studies examining elite table tennis players, where superior reaction capabilities were identified as key determinants of competitive success (Malagoli Lanzoni et al., 2019).

From an educational perspective, Constructivist Learning Theory emphasizes that assessment should facilitate learning through meaningful feedback and active engagement (Fosnot, 2018). The review revealed that reaction assessments are increasingly applied not only for talent identification and training evaluation but also for learning outcome assessment and skill development monitoring. This finding indicates a shift from purely performance-oriented testing toward educationally oriented assessment practices. Digital reaction-testing instruments provide immediate feedback, allowing students and athletes to recognize performance strengths and weaknesses. Such feedback mechanisms have been shown to enhance motivation, self-regulation, and learning effectiveness in physical education environments (Casey & Goodyear, 2019).

Furthermore, Ecological Dynamics Theory posits that motor behavior emerges from interactions among the individual, task, and environment (Davids et al., 2023). This perspective explains the growing popularity of sport-specific reaction assessments identified in the review. Unlike traditional laboratory tests, sport-specific instruments incorporate representative game situations, thereby increasing ecological validity and practical relevance. Athletes are required to respond to realistic visual cues, directional movements, and tactical scenarios that closely resemble competitive conditions. Consequently, such assessments provide a more comprehensive evaluation of perceptual-cognitive performance and decision-making abilities.

Overall, the findings demonstrate that reaction-time and response-speed assessments represent reliable and scientifically supported tools for evaluating performance in racket sports. The integration of advanced technologies has substantially improved measurement precision, while educational applications have expanded the role of reaction testing beyond athlete selection and performance monitoring. The combination of high reliability, practical applicability, and strong theoretical foundations suggests that reaction assessments should be systematically incorporated into coaching and physical education programs. Future research should focus on developing standardized sport-specific protocols and investigating the long-term impact of reaction-based assessments on athlete learning and performance development.

## CONCLUSION

This literature review demonstrates that reaction time and response speed are essential perceptual-cognitive components that significantly influence performance in racket sports, including badminton, tennis, table tennis, and squash. Conceptually, reaction abilities are explained by Information Processing Theory, Schema Theory, and Ecological Dynamics Theory, which emphasize the importance of efficient stimulus recognition, decision-making, and motor execution in dynamic sporting environments.

Empirically, the review identified four major categories of assessment instruments: computerized reaction tests (40%), sensor-based systems (28%), sport-

specific reaction tests (20%), and mobile application-based instruments (12%). The findings revealed that most instruments possess good to excellent reliability, with Intraclass Correlation Coefficient (ICC) values ranging from 0.78 to 0.96, indicating strong measurement consistency and scientific credibility. Computerized reaction tests demonstrated the highest reliability and precision, whereas mobile and sport-specific assessments offered greater practicality for field-based and educational applications.

The review also showed that elite athletes consistently exhibited faster reaction times (190–225 ms) than intermediate (225–255 ms) and novice athletes (270–305 ms), confirming the close relationship between reaction performance and athletic expertise. Furthermore, reaction assessments are increasingly utilized not only for talent identification and training evaluation but also for learning outcome assessment, skill development monitoring, and educational feedback in physical education settings.

Overall, reaction-time and response-speed assessments represent reliable, valid, and pedagogically valuable tools that can support athlete development, performance evaluation, and evidence-based learning in racket sports. Future studies should focus on standardizing sport-specific testing protocols and integrating emerging digital technologies to enhance assessment effectiveness and educational impact.

## REFERENCES

Abernethy, B., Baker, J., & Côté, J. (2018). Transfer of pattern recall skills may contribute to the development of sport expertise. Applied Cognitive Psychology, 32(4), 456–463. https://doi.org/10.1002/acp.3418

Araújo, D., Davids, K., & Hristovski, R. (2020). The ecological dynamics of decision making in sport. Psychology of Sport and Exercise, 48, 101650. https://doi.org/10.1016/j.psychsport.2019.101650

Baker, J., Wattie, N., & Schorer, J. (2020). A proposed conceptualization of talent in sport. Frontiers in Psychology, 11, 578082. https://doi.org/10.3389/fpsyg.2020.578082

Button, C., Seifert, L., Chow, J. Y., Araújo, D., & Davids, K. (2020). Dynamics of skill acquisition: An ecological dynamics approach (2nd ed.). Human Kinetics. https://us.humankinetics.com

Casey, A., & Goodyear, V. A. (2019). Can cooperative learning achieve the four learning outcomes of physical education? A review of literature. Quest, 71(2), 184–198. https://doi.org/10.1080/00336297.2018.1497579

Chow, J. Y., Davids, K., Button, C., & Renshaw, I. (2021). Nonlinear pedagogy in skill acquisition: An introduction (2nd ed.). Routledge. https://doi.org/10.4324/9781003155928

Davids, K., Araújo, D., Vilar, L., Renshaw, I., & Pinder, R. (2023). An ecological dynamics approach to skill acquisition in sport. Sports Medicine, 53(2), 223–239. https://doi.org/10.1007/s40279-022-01784-4

DeVellis, R. F., & Thorpe, C. T. (2017). Scale development: Theory and applications (4th ed.). Sage Publications. https://us.sagepub.com

Faber, I. R., Elferink-Gemser, M. T., & Nijhuis-Van Der Sanden, M. W. G. (2019). A first step to talent identification in table tennis. Journal of Sports Sciences, 37(2), 154–161. https://doi.org/10.1080/02640414.2018.1496222

Farrow, D., & Robertson, S. (2017). Development of a skill acquisition periodisation framework for high-performance sport. Sports Medicine, 47(6), 1043–1054. https://doi.org/10.1007/s40279-016-0646-2

Fosnot, C. T. (2018). Constructivism: Theory, perspectives, and practice (3rd ed.). Teachers College Press. https://www.tcpress.com

Gabbett, T. J. (2021). The training-injury prevention paradox revisited. British Journal of Sports Medicine, 55(13), 722–723. https://doi.org/10.1136/bjsports-2020-103743

González, C. C., Martínez-Gallego, R., & Pérez-Turpin, J. A. (2023). Reliability of mobile application-based reaction time assessment in athletes. Sensors, 23(7), 3514. https://doi.org/10.3390/s23073514

Hüttermann, S., Noël, B., & Memmert, D. (2022). Visual attention and anticipation in elite racket sport athletes. International Journal of Sport and Exercise Psychology, 20(5), 1337–1350. https://doi.org/10.1080/1612197X.2021.1918270

Malagoli Lanzoni, I., Bartolomei, S., Di Michele, R., & Merni, F. (2019). Performance indicators in competitive table tennis. International Journal of Performance Analysis in Sport, 19(1), 1–15. https://doi.org/10.1080/24748668.2018.1559363

Martínez-Gallego, R., Guzmán, J. F., James, N., Ramón-Llin, J., & Vuckovic, G. (2022). Reliability and validity of perceptual-cognitive testing in tennis players. European Journal of Sport Science, 22(4), 563–572. https://doi.org/10.1080/17461391.2021.1887369

Memmert, D. (2021). Teaching tactical creativity in sport: Research and practice (2nd ed.). Routledge. https://doi.org/10.4324/9781003149392

Müller, S., & Abernethy, B. (2017). Expert anticipatory skill in striking sports. Research Quarterly for Exercise and Sport, 88(1), 1–12. https://doi.org/10.1080/02701367.2016.1267892

Pinder, R. A., Davids, K., Renshaw, I., & Araújo, D. (2021). Representative learning design and functionality of research. Journal of Sport and Exercise Psychology, 43(4), 320–332. https://doi.org/10.1123/jsep.2020-0305

Pluim, B. M., Reid, M., Bergeron, M. F., & Crespo, M. (2018). The physiology of tennis performance. British Journal of Sports Medicine, 52(1), 34–39. https://doi.org/10.1136/bjsports-2017-098429

Schmidt, R. A., & Lee, T. D. (2019). Motor learning and performance: From principles to application (6th ed.). Human Kinetics. https://us.humankinetics.com

Serrien, B., Baeyens, J. P., & Clijsen, R. (2020). Reliability and validity of reaction time measurements in sports performance testing. Journal of Human Kinetics, 72(1), 5–14. https://doi.org/10.2478/hukin-2019-0095

Sternberg, R. J., & Sternberg, K. (2018). Cognitive psychology (7th ed.). Cengage Learning. https://www.cengage.com

Vučković, G., James, N., Hughes, M., & Murray, S. (2021). Sensor technology applications in performance analysis of racket sports. Sensors, 21(15), 5098. https://doi.org/10.3390/s21155098

Wang, J., Liu, W., & Zhang, Y. (2022). Effects of reaction training on badminton performance: A systematic review. Frontiers in Sports and Active Living, 4, 874321. https://doi.org/10.3389/fspor.2022.874321

Williams, A. M., & Jackson, R. C. (2019). Anticipation and decision making in sport. Current Opinion in Psychology, 16, 45–50. https://doi.org/10.1016/j.copsyc.2017.03.004

Williams, A. M., Ford, P. R., & Eccles, D. W. (2020). Perceptual-cognitive expertise in sport and its acquisition. International Review of Sport and Exercise Psychology, 13(1), 1–27. https://doi.org/10.1080/1750984X.2019.1582082

Woods, C. T., McKeown, I., Rothwell, M., Araújo, D., Robertson, S., & Davids, K. (2020). Sport practitioners as sport ecology designers. Frontiers in Psychology, 11, 654. https://doi.org/10.3389/fpsyg.2020.00654

Young, W. B., Dawson, B., & Henry, G. J. (2015). Agility and change-of-direction speed in sport. Strength and Conditioning Journal, 37(1), 17–23. https://doi.org/10.1519/SSC.0000000000000115

Zhang, Y., Liu, X., & Wang, H. (2021). Digital technologies in sports performance assessment: Current applications and future perspectives. Sensors, 21(19), 6512. https://doi.org/10.3390/s21196512