COACHING & SPORT SCIENCE REVIEW

International Tennis Federation
www.itfcoachingreview.com
April 2026. 34th Year. Issue 98. 11-15
ISSN 2225-4757
https://doi.org/10.52383/itfcoaching.v34i98.744

From Brain to Court: How Executive Functions Shape Self-Regulation in Tennis

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ABSTRACT

Tennis places high demands on player's cognitive and emotional capacities, requiring continuous attention, fast decision-making, emotional control, and sustained effort. This conceptual and narrative review examines the role of executive functions; specifically inhibitory control, working memory, and cognitive flexibility in supporting tennis performance. Drawing from research in cognitive neurosciences and sport psychology, we describe how executive functions influence performance both directly and indirectly through self-regulation. Self-regulation is described as a multidimensional process involving the regulation of attention, emotion, and effort, with each component influenced by underlying executive capacities. For coaches, the practical implication is that executive functions can be easily trained within regular tennis practice by manipulating cues, rules, and contextual demands to challenge these functions. We provide guidelines and concrete examples for integrating the training of inhibition, working memory, and cognitive flexibility into on-court exercises. Developing executive functions offers an accessible, evidence-informed approach to enhancing player's mental stability, adaptability, and overall performance.

Key words: Tennis, Neurocognitive functions, Executive Functions, Self-Regulation

Received: 4 December 2025

Accepted: 27 March 2026

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INTRODUCTION

Tennis is one of the most cognitively and emotionally demanding sports. Performance depends heavily on a player's ability to make fast decisions, regulate emotions, and sustain attention over time under unpredictable and high-pressure conditions. Today, success at high levels of play depends also on the ability to adapt efficiently to changing situations, rather than on purely physical or technical advantages (Vestberg et al., 2012).

Over the past decade, research in sport and cognitive neurosciences has highlighted the crucial role of executive functions (a set of mental processes that help us control our attention, emotions and behavior) (Diamond, 2013). They include inhibition (the ability to resist impulses or frustration), working memory (the ability to keep relevant information active while executing actions), and cognitive flexibility (the ability to adapt strategies when needed). Although these skills are not directly visible, they are deeply involved in how players manage their thoughts and actions during matches (and practices).

Beyond cognitive performance, these capacities form the foundation of mental self-regulation which is defined as the capacity to guide one's behavior toward the desired goals over time (Hofmann et al., 2012). For example, when a player stays calm after a double fault, adjusts their tactics during the point, or keeps concentration despite the noise and the pressure, executive functions are strongly engaged. In this sense, executive functions are not only cognitive capacities but also mechanisms of mental consistency.

Building on existing theoretical models and empirical findings, this article presents a conceptual and narrative review aimed at introducing executive functions in the context of tennis, clarifying their relationship with self-regulation, and discussing practical implications for coaching and player development.

EXECUTIVE FUNCTIONS AND TENNIS PERFORMANCE

In open-skill sports such as tennis, players must continually adapt their perception, decision-making, and motor responses to rapidly changing and unpredictable situations. These demands place a crucial importance on executive functions.

A growing body of evidence suggests that athletes who regularly engage in open-skill sports show higher executive functioning compared with those in closed-skill sports (where the environment is stable and movement patterns planned) (Krenn et al., 2018; C. H. Wang et al., 2013). The mental challenges inherent in open-skill contexts (anticipating opponent's behaviors, shifting between offensive and defensive modes, unpredictability etc.) seem to strengthen neural networks associated with executive functions. Within tennis, these processes are activated continuously. Indeed, performance relies on the ability to execute a tactical plan with precision while adapting to the fast pace of play and

the constant flow of information on court. Players who can efficiently manage these demands, such as staying aligned with their tactical intentions and minimized the impact of external or match-related distractions, tend to maintain greater competitive consistency.

Empirical findings support this connection between executive functions and tennis performance. For example, a recent scoping review highlighted that athletes (from different sports) exhibit faster and more efficient inhibitory control than non-athletes, and that higher expertise levels are associated with superior inhibitory performance (Simonet et al., 2023). More specifically, (Ishihara et al., 2019) showed that young tennis players with higher executive function scores had greater ranking improvements over an 18-month period compared to those with lower executive function scores. This suggest that these capacities may facilitate learning, tactical adaptation, and long-term skill consolidation. Moreover, (Kuroda et al., 2023) reported that a decline in executive functions over the course of a tennis exercise was associated with a reduced second-serve precision in college tennis players. This finding illustrates how mental fatigue can directly affect technical execution under pressure. Together, these studies suggest that executive functions contribute positively to tennis performance in two ways: first, moment-to-moment decision making, and second, by maintaining performance consistency across extended periods of competition and training.

Table 1
Definitions of the core executive functions and their functional relevance to performance in tennis.

Executive Function	Definition	Match Play Example
Inhibitory Control	The ability to control attention, behavior, thoughts, and emotions to override distractions.	After an error, the player controls frustration and avoids rushing the next point.
Working Memory	The ability to hold and manipulate information mentally (e.g., planning, decision making).	The player remembers key information about the opponent and match situation and uses it to choose the best tactical option.
Cognitive Flexibility	The ability to adapt and shift tactics based on changing situations.	The player switches tactic when needed without increased mental strain.

HOW EXECUTIVE FUNCTIONS UNDERPIN SELF-REGULATION

Beyond their direct impact on performance, executive functions also play a role in supporting the self-regulation processes that underpin consistent and resilient play. Self-regulation capacity is defined by the ability to manage thoughts, emotions and behaviors to maintain goal-directed performance under pressure (Hofmann et al., 2012). Studies show that in competitive contexts, mental self-regulation is often what separates consistent performers from those who fluctuate in their level of play (Englert, 2025).

Successful self-regulation requires three key elements according to Hofmann et al. (2012):

1. People have clear ideas about how they want to think, feel, and act, which help guide them toward their goals.
2. They are motivated to reduce the gap between how things are and how they want them to be.
3. They can make those changes, even when it's difficult or tempting to give up. As well as resisting distractions and impulses that interfere with the goal pursuit.

In tennis, self-regulation refers to a player's ability to maintain control over attention, emotions, and effort to stay aligned with performance goals. Below, we outline how executive functions provide the cognitive foundation for self-regulation by influencing each of these three key domains.

Attention regulation

Attention regulation is an essential component in tennis. Players must track the ball, anticipate the opponent's intentions, and filter out irrelevant information such as previous mistakes, noise, or intrusive thoughts. Executive functions support this attentional stability by enabling players to maintain task-relevant goals in mind (working memory) and suppress distractions (inhibitory control). In this way, research showed a positive relationship between executive functions and visual attention capacity in sport (Brimmell et al., 2024) . More specifically, Furley & Wood, (2016) showed that strong working memory improves athlete's ability to maintain attentional focus during dynamic tasks. Also, meta-analytic evidence suggests that athlete generally outperform non-athlete in both inhibition and attentional task (Ren et al., 2025). Overall, these findings highlight that attentional regulation depends strongly on executive control. When players can efficiently suppress distractions and maintain task-relevant information, they are better able to perform consistently.

Emotion regulation

Tennis exposes players to frequent emotional challenges: frustration, anxiety, anger, pressure. Effective emotional regulation requires the ability to inhibit impulsive emotional reactions and maintain a clear focus on performance goals. Hofmann et al. (2012), identify inhibitory control as a central mechanism for resisting emotional impulses. Working memory is also increasingly recognized as a key resource for managing emotional responses. It provides the mental workspace necessary to regulate unwanted emotions and impulses. For example, research showed that higher working memory capacity supports cognitive reappraisal which is the ability to reinterpret a situation to reduce its emotional impact (Schmeichel & Demaree, 2010). In parallel, cognitive flexibility plays a protective role in emotional regulation. Recent evidence shows that individuals with higher cognitive flexibility experience better emotional regulation during stress exposure (X. Wang et al., 2025). Taken together, these findings show that emotional regulation depends strongly on executive control.

For tennis players, these executive capacities are essential. Strong inhibitory control helps suppress impulsive emotional reactions allowing them to pause, breathe, and avoid rushing into the next point. High working memory capacity enables athletes to hold their tactical goals in mind while processing

emotional cues. In parallel, cognitive flexibility supports a more adaptative emotional response during momentum swings or stressful phases of a match, helping players shift from frustration to tactical adjustments.

Effort regulation

Maintaining effort and motivation across long matches or difficult moment requires self-regulation. Players need to hold long-term goals in mind, inhibit the urge to disengage or reduce effort as well as deal with challenges continuously. According to the strength model of self-regulation, maintaining effort under pressure relies on limited resources that can become depleted through stress, fatigue, and emotions (Baumeister et al., 2007). A growing body of research shows that executive functions play a central role in sustaining effort, especially under conditions of fatigue or psychological strain. Studies using endurance or exertion paradigms consistently show that when executive resources are depleted, athletes tend to disengage earlier. For example, Marcora et al. (2009) showed that mental fatigue induced by cognitive task targeting inhibitory control, working memory, and sustained attention reduced endurance performance, despite no physiological changes. Similarly, a systematic review by Van Cutsem et al. (2017) confirmed these findings, showing that mental fatigue consistently impairs physical performance by overloading executive mechanisms involved in effort regulation.

For tennis players, these findings highlight that the ability to sustain effort during demanding phases of a match depends partly on executive functioning. When executive resources are still available, players are better able to stay engaged, tolerate discomfort, and maintain intensity during demanding phase of a match.

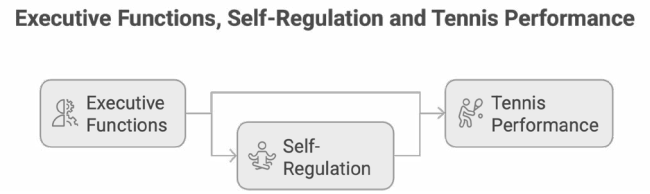

Figure 1. *This conceptual model illustrates how executive functions may contribute to tennis performance both directly and indirectly. Executive functions support performance by enabling players to manage cognitive demands leading to efficient decision-making, and tactical adaptation. They may also influence performance indirectly through their role in shaping self-regulation capacity, which encompasses the regulation of attention, emotions, and effort during competition.*

PRACTICAL IMPLICATIONS FOR TENNIS COACHING

For tennis coaches, understanding executive functions is essential because these cognitive skills directly affect a player's ability to stay focused, manage emotions, and make efficient decisions under pressure. Technical or tactical drills alone cannot guarantee consistent performance if a player struggles to inhibit frustration, maintain tactical plan, or adapt to changing match situations. Executive functions are not abstract constructs, they are measurable, trainable and influence the match-play intelligence, emotional stability and adaptability.

Importantly, executive-function training should be implemented progressively and in a controlled manner. Rather than being applied systematically in every session, cognitively demanding drills may be introduced one to two times per week, or in short sequences within a session, depending on the player's level and training phase. Excessive or constant cognitive load may lead to mental fatigue and reduced learning efficiency.

Coaches are therefore encouraged to carefully manage dosage by gradually increasing task complexity over time. In this process, monitoring mental load is particularly important. Simple tools such as a subjective mental RPE (Rating of Perceived Exertion) scale can help coaches identify at what level of intensity or complexity a player begin to experience cognitive overload. This information allows coaches to better individualize training, alternating between cognitively demanding and more automatic drills, and progressively increasing the player's tolerance to mental load. The objective is not to push player into constant overload, but to systematically build their cognitive reserve.

Finally, coaches are encouraged to clearly explain the cognitive objective of each drill and its relevance to tennis performance. Clarifying why a drill is important helps players better understand its purpose, increases engagement, and supports motivation. Moreover, in exercises where players are required to follow a specific direction or game plan, it is essential that these rules are respected regardless of how well they align with the immediate situational context. Without this consistency, the cognitive demands of the task are reduced, and the effectiveness of the training may be substantially diminished.

In the following sections, we outline practical ways for coaches to integrate executive function training directly into tennis practice.

Inhibitory control

Inhibitory control can be trained through exercises that require players to suppress automatic reactions (motor, attentional, or emotional). Inhibitory demands are highly important when players need to avoid rushing between points, prevent over-hitting under pressure, or resist the urge to react emotionally after a mistake. In practice, inhibitory control can be trained not only by imposing constraints, but also by designing situations that encourage players to inhibit impulsive decisions through meaningful incentives that preserve their autonomy.

Key elements to include in drills that target inhibitory control:

- Use of distractions (visual or auditory).

o Example: During a rally, the coach randomly introduces visual or auditory distractions (clapping, calling the player's name, moving an object in the visual field of the player etc.). The player must continue to play while ignoring the distractions and maintaining a high precision.

- A rule that encourages inhibition of an automatic pattern in course.

o Example: During a rally, the player always hits crosscourt unless the coach says "switch" then plays down the line. Decreasing the switch signal delay leads to a higher level of task difficulty (announced before, during, or after the ball bounces).

o Example: During a rally, the player is encouraged to attack any short ball, but when the coach raises a hand or claps, the player is also allowed to play a drop shot. A bonus point is awarded if he succeeds in the drop shot. In this exercise, the coach must choose carefully when to make the announcement.

• Emotional or competitive pressure.

o Example: During points situations, the coach may deliberately award the point to the opponent if a technical execution is judged imprecise, thereby encouraging the player to manage their frustration.

Working memory

Working memory is engaged when players must hold information in mind while playing, maintain a tactical intention, or update rules during action. Drills that require remembering sequences load this system effectively.

Key elements to include in drills that target working memory:

• A tactical instruction to maintain throughout the drill.

o Example: Play only cross with the backhand and change the direction (right/left) of your forehand on every shot. The change of direction on the forehand must alternate from point to point and at each change of game. This means that if the last forehand of the previous point was played to the right, the first forehand of the next point or game must be played on the left.

• A rule that must be updated based on cues.

o Example: The coach calls a color: red = defend, blue = attack, green = play a slice, yellow = play a dropshot etc. and the player must adjust instantly. The task can be further complexified by associating each color with an additional number that matches a color (1 = Red, 2 = blue, 3 = green, 4 = yellow).

• Short sequences to remember and execute during the whole match or set.

o Example: Serve on T → play deep crosscourt / Serve Wide → play the opposite direction. The goal of this exercise is to maintain a game plan in working memory over an extended period (e.g. an entire set or match).

• A dual task combining hitting and cognitive load.

o Example: Play a point after memorizing a sequence of numbers announced by the coach. Winning the point is only validated if the player can accurately recall the sequence afterward.

Cognitive flexibility

Cognitive flexibility is trained when players must switch strategies, adapt to sudden changes, or shift their mental state based on context. In tennis, this includes adjusting to different ball trajectories, tactical changes from the opponent, or shifts in momentum.

Key elements to include in drills that target cognitive flexibility:

• Switching between strategies within the same drill.

o Example: The player and the coach predetermine three playing styles. Before each point, the coach informs the player which style must be adopted for the upcoming point.

• Contextual changes requiring immediate adaptation.

o Example: When the coach raises a cone, the player must win the point within his next 2 shots.

• Mental state shift.

o Example: Whenever the player perceives a drop in intensity or attentional focus, they must deliberately modify their mental state by engaging in a predetermined behavioral strategy (e.g. shouting on every shot, intentionally slowing their steps between points, or adopting an exaggeratedly relaxed hitting style).

• Situations requiring reinterpretation or reframing.

o Example: The player adopts a highly aggressive playing style for the first three shots; if the rally continues (from the fourth shot onward), the player must switch to a more conservative style (e.g., playing crosscourt only).

CONCLUSION

Executive functions and self-regulation play a central role in tennis performance, shaping a player's capacity to stay focused, adapt tactically, manage emotions, and sustain effort under pressure. Although these processes operate "behind the scenes", their influence on consistency, resilience and decision-making is evident during a match. The evidence reviewed in this article highlight that executive functions support performance both directly by enabling players to process information efficiently, and indirectly through their contribution to self-regulation abilities.

For coaches, acknowledging the cognitive dimension of tennis allows them to actively contribute to their player's mental training in partnership with other sport professionals. Indeed, executive functions can be easily integrated into on-court drills by manipulating cues, constraints, and tactical demands to challenge inhibition, working memory, and cognitive flexibility. Such training can help to enhance not only cognitive skills on court, but also the mental stability and adaptability required for high-level performance.

However, several limitations and open questions should be acknowledged. Most existing studies examining executive functions in sport rely on laboratory-based or generic cognitive tasks, which may only partially reflect the complex and dynamic demands of real tennis environments. Moreover, the causal relationship between executive-function training and long-term performance improvements remains insufficiently established, particularly in tennis-specific contexts. Individual differences related to age, expertise level, and training history may also moderate the effectiveness of such interventions. Future research should therefore aim to develop more ecologically assessment tools, examine longitudinal effects of executive-function training, and clarify how these capacities interact with technical, physical, and psychological factors in player development.

As the game continues to evolve in speed, physical intensity, and tactical complexity, developing executive functions may represent a promising avenue for supporting player's long-term development. Rather than being viewed as a stand-alone solution, executive-function training may complement existing technical, physical, and psychological approaches by helping player better cope with the cognitive and emotional demands of competition. Training the brain alongside the body offers a promising practical, evidence-informed approach to improving the quality and consistency of tennis performance.

DECLARATION OF CONFLICT OF INTEREST AND FUNDING

The authors declare that they are not aware of any conflict of interest in writing this article and that they have not received any funding for this study.

REFERENCES

Baumeister, R. F., Vohs, K. D., & Tice, D. M. (2007). The strength model of self-control. Current Directions in Psychological Science, 16(6), 351–355. https://doi.org/10.1111/j.1467-8721.2007.00534.x

Brimmell, J., Edwards, E. J., & Vaughan, R. S. (2024). Executive function and visual attention in sport: a systematic review. International Review of Sport and Exercise Psychology, 17(2), 1278–1311. https://doi.org/10.1080/1750984X.2022.2145574

Diamond, A. (2013). Executive functions. In Annual Review of Psychology (Vol. 64, pp. 135–168). Annual Reviews Inc.

Englert, C. (2025). Self- control – A critical discussion of a key concept in sport and exercise psychology. Psychology of Sport and Exercise, 80, 102878. https://doi.org/10.1016/j.psychsport.2025.102878

Furley, P., & Wood, G. (2016). Working Memory, Attentional Control, and Expertise in Sports: A Review of Current Literature and Directions for Future Research. Journal of Applied Research in Memory and Cognition, 5(4), 415–425. https://doi.org/10.1016/j.jarmac.2016.05.001

Hofmann, W., Schmeichel, B. J., & Baddeley, A. D. (2012). Executive functions and self-regulation. In Trends in Cognitive Sciences (Vol. 16, Issue 3, pp. 174–180).

Ishihara, T., Kuroda, Y., & Mizuno, M. (2019). Competitive achievement may be predicted by executive functions in junior tennis players: An 18-month follow-up study. Journal of Sports Sciences, 37(7), 755–761. https://doi.org/10.1080/02640414.2018.1524738

Krenn, B., Finkenzeller, T., Würth, S., & Amesberger, G. (2018). Sport type determines differences in executive functions in elite athletes. Psychology of Sport and Exercise, 38, 72–79. https://doi.org/10.1016/j.psychsport.2018.06.002

Kuroda, Y., Ishihara, T., & Mizuno, M. (2023). Association between perceived exertion and executive functions with serve accuracy among male university tennis players: A pilot study. Frontiers in Psychology, 14, 1007928. https://doi.org/10.3389/fpsyg.2023.1007928

Marcora, S. M., Staiano, W., & Manning, V. (2009). Mental fatigue impairs physical performance in humans. Https://Doi.Org/10.1152/Japplphysiol.91324.2008, 106(3), 857–864. https://doi.org/10.1152/japplphysiol.91324.2008

Ren, S., Shi, P., Feng, X., Zhang, K., & Wang, W. (2025). Executive Function Strengths in Athletes: a Systematic Review and Meta-Analysis. Brain and Behavior, 15(1), e70212. https://doi.org/10.1002/brb3.70212

Schmeichel, B. J., & Demaree, H. A. (2010). Working Memory Capacity and Spontaneous Emotion Regulation: High Capacity Predicts Self-Enhancement in Response to Negative Feedback. Emotion, 10(5), 739–744. https://doi.org/10.1037/A0019355

Simonet, M., Beltrami, D., & Barral, J. (2023). Inhibitory control expertise through sports practice: A scoping review. Journal of Sports Sciences, 41(7), 616–630. https://doi.org/10.1080/02640414.2023.2230713

Van Cutsem, J., Marcora, S., De Pauw, K., Bailey, S., Meeusen, R., & Roelands, B. (2017). The Effects of Mental Fatigue on Physical Performance: A Systematic Review. Sports Medicine 2017 47:8, 47(8), 1569–1588. https://doi.org/10.1007/S40279-016-0672-0

Vestberg, T., Gustafson, R., Maurex, L., Ingvar, M., & Petrovic, P. (2012). Executive functions predict the success of top-soccer players. PLoS ONE, 7(4). https://doi.org/10.1371/journal.pone.0034731

Wang, C. H., Chang, C. C., Liang, Y. M., Shih, C. M., Chiu, W. S., Tseng, P., Hung, D. L., Tzeng, O. J. L., Muggleton, N. G., & Juan, C. H. (2013). Open vs. Closed Skill Sports and the Modulation of Inhibitory Control. PLoS ONE, 8(2). https://doi.org/10.1371/journal.pone.0055773

Wang, X., Shao, S., Cheng, H., Blain, S. D., Tan, Y., & Jia, L. (2025). Effects of cognitive flexibility on dynamics of emotion regulation and negative affect in daily life. Anxiety, Stress and Coping, 38(3), 365–378. https://doi.org/10.1080/10615806.2024.2423154

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