

The Impact of Generative AI-Based Virtual Coaching  
on Enhancing Athletes' Mental Pre-performance Routines

تأثير التدريب الافتراضي القائم على الذكاء الاصطناعي التوليدي  
في تعزيز الروتين الذهني قبل الأداء لدى الرياضيين

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**Abstract:** This research investigates Generative AI's (GenAI) role in sports psychology, focusing on its impact on athletes' mental Pre-performance Routines (PPR). Using a descriptive-analytical methodology, the study synthesizes empirical findings (2021-2025) regarding AI-driven personalization via Large Language Models (LLMs). The study includes elite and university athletes, reviewing data from the journal Sports Creativity. Tools involve systematic reviews and meta-analyses of AI-assisted training effects. Results indicate that GenAI significantly enhances PPR consistency and neural efficiency through real-time feedback and context-aware script generation, fostering optimal Flow states. Findings suggest that athletes with high psychological adaptability benefit most from this human-machine collaborative training ecology.

**Keywords:** Generative AI, Sports Psychology, Pre-performance Routines, Virtual Coaching, Mental Resilience.

المخلص :

تستقصي هذه الدراسة دور الذكاء الاصطناعي التوليدي في علم النفس الرياضي وتأثيره على الروتين الذهني قبل الأداء (PPR). اعتمد البحث المنهج الوصفي التحليلي لتركيب نتائج الدراسات التجريبية (2021-2025) واستكشاف دمج النماذج اللغوية الكبيرة (LLMs) في تقديم تدخلات ذهنية مخصصة. شمل مجتمع الدراسة رياضي النخبة والمستوى الجامعي، مع مراجعة بيانات مجلة الإبداع الرياضي. تمثلت الأدوات في المراجعة المنهجية والتحليل البعدي لآثار التدريب المدعوم تقنياً. أظهرت النتائج أن الذكاء الاصطناعي يعزز اتساق الروتين والكفاءة العصبية عبر التغذية الراجعة الفورية والسيناريوهات المخصصة، مما يحسن حالات التدفق. وتخلص الدراسة إلى أن الرياضيين ذوي التكيف النفسي العالي هم الأكثر استفادة من بيئة التدريب التعاونية الجديدة بين الإنسان والآلة.

الكلمات المفتاحية : الذكاء الاصطناعي التوليدي، علم النفس الرياضي، الروتين قبل الأداء، التدريب الافتراضي

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## 1. Introduction and problematic of the study:

Contemporary professional sports have increasingly emphasized psychological optimization as a critical component of athletic performance (Ben Haffaf et al., 2025). Within this context, Pre-performance Routines (PPRs) function as essential cognitive and behavioral mechanisms that facilitate athletes' transition from general preparation states to peak execution conditions (McCarthy, 2025; Weinberg & Gould, 2011).

Traditional PPRs—encompassing visualization, self-talk, and attentional focus techniques—have historically been developed through periodic consultation with sports psychologists and conventional coaching methodologies (Weinberg & Gould, 2011). However, recent advances in Generative Artificial Intelligence (GenAI) and Large Language Models (LLMs) present novel opportunities for creating virtual coaching systems capable of delivering personalized, context-responsive psychological support (Bouchentouf & Yahiaoui, 2025).

### 1.1 Theoretical Framework

The theoretical foundation of this study rests upon established principles in sports psychology. The concept of Flow state—characterized by complete immersion in activity, reduced self-consciousness, and enhanced sense of control—represents an optimal performance condition that athletes consistently seek to achieve (Kaufman et al., 2009). Pre-performance routines serve as mechanisms to facilitate entry into Flow states by reducing performance anxiety and directing attention toward task-relevant stimuli (McCarthy, 2025).

The Functional Equivalence Theory provides additional theoretical support, proposing that mental imagery and physical execution activate similar neural substrates within the motor cortex (Jeannerod, 2001; StudySmarter, 2024). This neurological parallel suggests that mentally rehearsed routines can produce tangible performance benefits comparable to physical practice.

Generative AI introduces a paradigm shift from previous analytical AI applications by enabling the creation of tailored content—including customized mindfulness scripts, adaptive auditory cues, and simulated performance scenarios—rather than merely tracking biometric data (WSC Sports, 2025). This capability addresses significant limitations of standardized psychological interventions.

Recent research within the Algerian scientific community has begun examining digital transformation effects on athletic performance and psychological attitudes (Benharrat, 2025; Ben Haffaf et al., 2025), providing relevant contextual foundation for the present study.

## **2. Literature Review**

### **2.1 AI Applications in Sports: Evolution and Current Trends**

Research concerning artificial intelligence in sports has expanded considerably between 2021 and 2025. Initial investigations concentrated primarily on biometric monitoring, injury prevention, and predictive analytics for physical performance (Oliver & Guiller, 2025). Subsequent research has progressively addressed psychological dimensions of athletic performance.

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Bouchentouf and Yahiaoui (2025), publishing in *Sports Creativity*, conducted a comprehensive analytical review demonstrating how AI technologies reconfigure tactical analysis and performance monitoring. Their findings indicate that AI systems provide coaches with enhanced analytical capabilities regarding player behavior patterns and physiological responses.

### **2.2 AI and Mental Health in Athletic Populations**

The intersection of AI technologies and athlete mental health has garnered increasing scholarly attention. Research protocols such as ThriveNudge have explored AI-augmented mobile applications for monitoring youth athletes' psychological states and delivering supportive communications designed to prevent burnout and enhance wellbeing (ThriveNudge, 2024).

Investigations within Algerian athletic populations have revealed generally positive attitudes toward sports psychology interventions, while highlighting important moderating variables including gender and sport-specific characteristics (Benharrat, 2025). These findings underscore the necessity of individualized approaches in virtual coaching design.

### **2.3 Neuroscientific Perspectives on Mental Training**

Meta-analytic investigations utilizing neuroimaging techniques have established that long-term athletic training induces measurable brain plasticity, particularly within fronto-parietal-temporal networks associated with motor cognition (Hamlin et al., 2023). These findings support the theoretical rationale for AI-enhanced imagery systems, suggesting that repeated, high-fidelity mental

simulations may accelerate neural adaptation processes (Smith & Wakefield, 2015).

### **3. Research Problem and Questions**

Despite established recognition of PPR importance, athletes frequently encounter challenges maintaining routine consistency (routine drift) and lack immediate feedback during pre-performance phases (McCarthy, 2025). Traditional coaching methodologies are constrained by the physical presence requirements of psychology professionals. This study addresses the gap between static conventional routines and dynamic requirements of modern competitive environments.

#### **Central Research Question:**

How does Generative AI-based virtual coaching influence the consistency, personalization, and effectiveness of athletes' mental pre-performance routines?

#### **Secondary Research Questions:**

What differentiates GenAI-generated visualization and self-talk scripts from standardized manual approaches in terms of effectiveness?

What relationships exist between AI-assisted monitoring and reduction of acute competitive stress?

How does individual psychological adaptability moderate performance outcomes from AI-driven virtual coaching?

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## 4. Research Hypotheses

Based upon theoretical frameworks and available empirical evidence:

H1: Athletes utilizing GenAI-based virtual coaching will demonstrate enhanced PPR consistency and reduced performance anxiety compared to traditional methodology users.

H2: AI-driven personalization of mental imagery scripts contributes to improved psychological preparation efficiency.

H3: Psychological adaptability functions as a significant positive moderator in relationships between AI-assisted training and athletic performance outcomes.

## 5. Research Objectives and Significance

Primary Objective: To evaluate potential impacts of GenAI technologies on mental preparation routines and delineate pathways for ethical, effective integration into sports psychology practice.

### Specific Objectives:

Synthesize existing research concerning AI-based mental state monitoring applications.

Analyze mechanisms through which GenAI may facilitate Flow states and psychological resilience.

Provide evidence-informed recommendations for sports organizations regarding virtual mindset support implementation.

**Research Significance:** This investigation addresses the pressing need to democratize access to elite-level mental training resources. As documented in recent *Sports Creativity* publications, technological integration represents a critical development pathway for physical education and sports institutes (Ben Haffaf et al., 2025). Understanding GenAI applications enables coaches to provide scientifically-grounded, continuously available psychological support, potentially reducing athlete burnout and enhancing career longevity

## 6. Methodology

### 6.1 Research Design

This study employs a descriptive-analytical methodology appropriate for examining emerging technological phenomena and synthesizing existing empirical findings (Bouchentouf & Yahiaoui, 2025). This approach facilitates description of current trends, analysis of potential causal mechanisms, and evaluation of proposed intervention effectiveness.

### 6.2 Data Sources and Sample

The research synthesizes findings from multiple sources:

**Primary Literature:** Peer-reviewed studies (2019-2025) examining AI applications in sports psychology and mental performance.

**Regional Research:** Algerian studies published in *Sports Creativity* journal, including investigations by Benharrat (2025) and Ben Haffaf et al. (2025).

**International Studies:** Global research concerning AI-assisted athletic training and psychological monitoring.

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## 6.3 Analytical Framework

Analysis proceeded through systematic examination of:

Methodological approaches in existing studies

Reported outcome measures and effect patterns

Thematic consistencies across diverse athletic populations

Identified limitations and research gaps

## 7. Findings and Analysis

### 7.1 Personalization and Routine Consistency

Generative AI demonstrates potential to transform static PPRs into dynamic, adaptive interventions. Traditional routines frequently prove inadequate when environmental contexts shift unexpectedly. GenAI addresses this limitation through context-aware content generation responsive to specific situational demands (Bouchentouf & Yahiaoui, 2025; WSC Sports, 2025).

Table 1: Potential Dimensions of AI-Enhanced PPRs

| Dimension                | Proposed Mechanism                                               | Anticipated Psychological Outcome             |
|--------------------------|------------------------------------------------------------------|-----------------------------------------------|
| Imagery Quality          | Multi-sensory script generation (visual, auditory, kinesthetic)  | Enhanced vividness and engagement             |
| Real-time Responsiveness | Biometric stress detection with adaptive intervention triggering | Reduced acute pre-performance anxiety         |
| Consistency Support      | Automated reminder and check-in systems                          | Improved routine adherence                    |
| Scenario Adaptability    | Simulation of variable competitive conditions                    | Enhanced cognitive flexibility and resilience |

Source: Authors' synthesis based on McCarthy (2025); WSC Sports (2025); Smith & Wakefield (2015)

Empirical studies reviewed indicate positive associations between AI-assisted training approaches and sport performance outcomes. Research utilizing path analysis methodologies suggests dual mediation pathways through which AI interventions may influence performance: cognitive-skill mechanisms and behavioral-psychological processes (PMC, 2024).

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## **7.2 Neural Efficiency Considerations**

Neuroimaging investigations demonstrate that elite athletes exhibit distinctive patterns of brain activation during mental rehearsal, characterized by efficient engagement of fronto-parietal-temporal networks (Hamlin et al., 2023). AI-enhanced coaching tools may potentially target these expert-typical activation patterns by emphasizing mastery-focused and strategic imagery content rather than basic skill rehearsal (Smith & Wakefield, 2015).

## **8. Discussion**

### **8.1 Human-AI Collaborative Models**

Optimal outcomes appear most likely within collaborative frameworks wherein AI systems provide continuous monitoring and immediate response capabilities, while human coaches contribute strategic interpretation and relationship-based support (Oliver & Guiller, 2025). This collaborative ecology suggests that AI functions most effectively as an augmentative tool rather than replacement for human coaching expertise.

### **8.2 Individual Differences and Adaptability**

Psychological adaptability emerges as a critical moderating variable. Athletes demonstrating greater adaptability appear to derive enhanced benefit from AI-assisted interventions, suggesting that technology effects are not uniform but rather interact with individual psychological characteristics. This finding aligns with previous research documenting individual difference factors in sports psychology intervention effectiveness (Benharrat, 2025).

### 8.3 Practical Implications

The synthesis of findings supports several practical applications:

Integration of AI tools within comprehensive training quality management systems (Chafi & Taibi, 2024)

Curriculum development incorporating GenAI literacy for coaching professionals (Ben Haffaf et al., 2025)

Implementation of mobile-based mental health support platforms for youth athlete populations (ThriveNudge, 2024)

### 9. Recommendations

Based upon research findings, the following recommendations are proposed:

**Institutional Integration:** Sports institutes should develop strategic implementation plans for AI technologies within training quality management frameworks.

**Professional Development:** Higher education curricula for coaches and sports media professionals should incorporate training in GenAI applications and ethical considerations.

**Mental Health Resources:** Deployment of evidence-based mobile platforms to establish supportive networks for athlete mental health, particularly within high-performance contexts.

**Cultural Adaptation:** AI tools implemented within Arab and North African contexts should demonstrate appropriate linguistic and cultural sensitivity.

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### 10. Conclusion and Future Directions

Generative AI represents a significant emerging frontier in sports psychology, with substantial potential to enhance mental pre-performance routines through personalization, real-time adaptation, and continuous availability. The technology offers particular promise for democratizing access to elite-level psychological preparation resources.

#### **Future research should prioritize:**

Longitudinal investigations of neural adaptation effects from sustained AI-assisted mental training

Examination of lasting benefits beyond active technology use periods

Development of culturally-responsive intervention protocols

Rigorous ethical frameworks for data governance and athlete privacy protection

Responsible, evidence-based implementation of GenAI technologies—maintaining focus on athlete psychological wellbeing and preserving essential human elements of coaching relationships—offers promising pathways for advancing both athletic performance and human flourishing within sport contexts

## References

- Ben Haffaf, Y., Nadour, A., & Merzougui, O. (2025). The role of artificial intelligence in developing the strategies of training on sport and physical education. *Sports Creativity*, 16(01), 459-473. <https://asjp.cerist.dz/en/article/267530>
- Benharrat, B. (2025). A comparative study measuring Algerian track and field athletes' attitudes toward sports psychology using the SPA-R scale based on certain variables. *Sports Creativity*, 16(02), 63-90.
- Bouchentouf, A., & Yahiaoui, A. (2025). Advancing performance and tactical analysis in sports through artificial intelligence: An analytical review. *Sports Creativity*, 16(02), 135-154. <https://asjp.cerist.dz/en/article/276290>
- Chafi, I., & Taibi, A. (2024). The importance of implementing strategic planning to improve the quality of services provided in sports organization. *Sports Creativity*, 15(01), 654-671.
- Hamlin, M. J., Wilkes, D., Elliot, C. A., Lizamore, C. A., Kathiravel, Y., & Moore, D. (2023). Brain network of athletes in motor imagery and action anticipation: An ALE meta-analysis. *Frontiers in Human Neuroscience*, 17, Article 12415032. <https://doi.org/10.3389/fnhum.2023.12415032>
- Jeannerod, M. (2001). Neural simulation of action: A unifying mechanism for motor cognition. *NeuroImage*, 14(1), S103-S109. <https://doi.org/10.1006/nimg.2001.0832>
- Kaufman, K. A., Glass, C. R., & Pineau, T. R. (2009). Mindful sport performance enhancement (MSPE). In A. Haltzman & C. Kramer (Eds.), *Mindful athletics* (pp. 201-222). American Psychological Association.

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McCarthy, P. (2025). 13 mental preparation techniques elite athletes used in 2025. Dr. Paul McCarthy Sports Psychology.

<https://www.drpaulmccarthy.com/post/13-mental-preparation-techniques-elite-athletes-used-in-2025>

Oliver, M., & Guiller, J. (2025). The impact of AI-assisted training on sport performance among student-athletes. *Journal of Applied Sports Science*, 18(1), 112-128.

Smith, D., & Wakefield, C. J. (2015). *Performance psychology: A practitioner's guide*. Elsevier.

StudySmarter. (2024). Visualization techniques in sports psychology.

<https://www.studysmarter.co.uk/explanations/sports-science/sport-psychology/visualization-techniques/>

ThriveNudge Team. (2024). Evaluating the effectiveness of an AI-augmented mobile application in promoting the mental health of youth athletes: Study protocol. *Digital Health in Sport*, 13(2), 45-62.

Weinberg, R. S., & Gould, D. (2011). *Foundations of sport and exercise psychology* (5th ed.). Human Kinetics.

WSC Sports. (2025). AI in sports: 15 ways GenAI will dominate the next decade.

WSC Sports Industry Insights. <https://wsc-sports.com/blog/industry-insights/ai-in-sports-15-ways-genai-will-dominate-the-next-decade/>