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BEYOND CONVENTIONAL MENTAL SKILLS TRAINING IN SPORTS: A CRITICAL REVIEW OF CURRENT PARADIGMS

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ABSTRACT

Mental skills training (MST) has emerged as a critical component in optimizing sports performance, complementing physical training. This review challenges conventional perspectives by providing a critical re-evaluation of MST, delving into core mental skills, their theoretical underpinnings, and exploring new frameworks that reshape the field. Key mental strategies such as goal setting, visualization, self-talk, concentration, and arousal regulation are critically reviewed, with particular emphasis on their practical application in diverse sports contexts. A comprehensive literature search from inception to July 2024 was conducted using the databases Web of Science, Scopus, and PsycINFO, and twenty-one (N=21) peer-reviewed studies met the inclusion criteria. This review questions traditional approaches to MST, proposing it as not just a supplementary tool but a transformative force in athletic development. It argues for a more adaptive and integrative approach to MST, accounting for individual and contextual variability in sports performance. Through a critical analysis of both established practices and emerging trends, this review aims to challenge current thinking, inspire innovative MST strategies, and introduce novel insights that can holistically empower athletes to meet the increasingly complex psychological demands of competitive sports.

Keywords: *goal setting, visualization and imagery, self-talk, concentration and focus, arousal regulation*

INTRODUCTION

Importance of Mental Skills Training in Sports Performance

Mental skills training (MST) are widely acknowledged as crucial for achieving peak performance in sports, enabling athletes to maintain focus, manage stress, and enhance their psychological well-being, which are key factors for consistent, high-level performance (Lange-Smith et al., 2023; Weinberg & Gould, 2018). However, in the high-stakes environment of competitive sports, reliance on physical prowess alone is increasingly recognized as insufficient. Athletes require a robust mental toolkit to navigate the complex psychological challenges that accompany both training and competition.

While MST is often framed as a tool for optimizing performance, this review critically examines the limitations and evolving nature of MST. Conventional techniques such as goal setting, visualization, and

self-talk, while effective in specific contexts, are often applied in a rigid manner, limiting their adaptability to the dynamic and unpredictable nature of competitive sports. For example, visualization techniques have been praised for enhancing preparedness and confidence (Stephen et al., 2022), but they may fall short in sports requiring rapid decision-making under fluctuating conditions. Similarly, positive self-talk is frequently recommended to counter negative thoughts and boost self-esteem (Sampogna et al., 2022), yet its efficacy may be compromised if overused or misaligned with realistic self-assessment. Concentration and focus are other critical aspects of MST (Diekfuss et al., 2019; Saemi et al., 2023), but traditional techniques like mindfulness and meditation may not be universally effective across all sports. While these methods can enhance concentration and engagement (Birrer et al., 2012; Piasecki et al., 2021; Trautwein et al., 2020), their applicability in high-pressure, reaction-based sports is still debatable. Furthermore, arousal regulation, typically managed through relaxation techniques, breathing exercises, and biofeedback (Birrer & Morgan, 2010), is an area where individualized and sport-specific approaches are needed to optimize performance without risking anxiety or burnout.

Beyond short-term performance gains, mental skills play a vital role in building long-term psychological resilience. Athletes who develop effective MST strategies are better equipped to handle setbacks, recover from failures, and maintain a positive outlook throughout their careers (Kegelaers et al., 2021). Yet, the broader question remains: Are current MST techniques adequately flexible and adaptable to meet the increasingly complex psychological demands of modern competitive sports? This review challenges conventional wisdom and advocates for a rethinking of MST as a more dynamic and individualized process.

Objectives and Scope of the Review

This review aims to provide a comprehensive and critical overview of MST in sports performance. The objectives are twofold:

(1) To critically examine current paradigm of MST and its effectiveness as a transformative technique for enhancing sports performance in athletes. This includes a re-evaluation of key techniques, challenging conventional applications and exploring their limitations and potential for innovation in diverse sports contexts.

(2) To identify the challenges and gaps in the current MST literature. This includes addressing the limitations in existing research while proposing directions for future research to enhance MST's applicability and effectiveness.

The scope of this review spans a comprehensive literature search since inception to July 2024, using databases such as Web of Science, Scopus, and PsycINFO. Through this review, we aim to bridge the gap between theory and practice, inspiring further research and the development of innovative MST strategies to enhance sports performance.

METHODOLOGY

Thematic Analysis

The themes for this review were pre-determined based on recurring concepts identified in the literature related to MST in sports. After an initial review of the selected studies, key themes such as goal setting, visualization, self-talk, concentration, and arousal regulation consistently emerged across the analyzed research, reflecting the core techniques used in MST to enhance sports performance.

Two independent reviewers (WH and NZA) conducted a thematic coding analysis to extract these themes from the studies. Any discrepancies in theme categorization were resolved through consensus discussions, ensuring the reliability and robustness of the thematic analysis. This approach provided a comprehensive evaluation of the MST techniques while critically assessing their practical application across different sporting contexts.

Literature Search Strategy

A comprehensive literature search spanning the period from inception to July 2024 was conducted using the databases Web of Science, Scopus, and PsycINFO. The search terms included "mental skills training," "psychological skills training," "mental training," and "psychological training" combined with terms related to sports performance such as "sports performance," "athletic performance," "performance enhancement," and "performance optimization." Additionally, key mental skills were incorporated into the search strategy, including "goal setting," "visualization," "imagery," "self-talk," "concentration," "focus," "arousal regulation," "relaxation techniques," "mindfulness," "meditation," and "biofeedback." The search strategy combined these terms using Boolean operators to create a comprehensive query.

The database search yielded approximately 356 records. After removal of duplicates, 248 records remained and were screened based on title and abstract. Of these, 47 full-text articles were assessed for eligibility. Following full-text evaluation against the inclusion criteria, 21 studies met the inclusion criteria and were included in the final synthesis. As this review involved secondary analysis of previously published studies, ethical approval was not required.

Inclusion and Exclusion Criteria

Studies were included in this review if they met the following criteria: they were published in peer-reviewed journals, focused on the application of MST within the context of sports performance, physical activity, or fitness, provided empirical data in the form of either qualitative or quantitative evidence on MST interventions, and were written in English. Studies were excluded if they were theoretical papers that did not present empirical data.

Study Selection

Two independent reviewers (WH and NZA) screened the titles and abstracts, and any discrepancies were resolved through discussion. The final selection included 21 studies that provided robust empirical evidence aligned with the inclusion criteria [Table 1-5].

RESULT AND DISCUSSION

The findings of this review reveal several consistent patterns across MST domains, while also highlighting important contextual boundaries that shape their effectiveness. Across the 21 included studies (Tables 1–5), MST interventions were generally associated with improvements in performance-related outcomes, psychological regulation, and attentional control. However, the strength and nature of these effects varied considerably depending on the type of mental skill, sport context, athlete characteristics, and implementation approach. Rather than supporting a uniform or prescriptive model of MST, the collective results point toward the importance of adaptability, individualisation, and contextual sensitivity in both research and applied practice. The following sections integrate these findings by synthesising evidence within each MST domain and critically examining their implications for contemporary sport psychology.

Goal Setting

Goal setting is a core mental skill in sports, providing athletes with direction, motivation, and structured pathways for performance improvement (Gardner et al., 2017; Healy et al., 2018a). When applied effectively, goal setting enhances focus, effort, and performance by aligning cognitive resources with task demands. Within this broader framework, different goal types serve distinct regulatory functions, particularly in how athletes allocate attention and manage performance demands.

Among these, process goals emphasise the execution of specific actions or techniques during training and competition (Gross et al., 2018; Van Yperen et al., 2014). By directing attention to controllable behaviours, process goals support skill execution and attentional regulation. Evidence from a randomized controlled trial comparing the Mindfulness-Acceptance-Commitment (MAC) approach with traditional Psychological

Skills Training (PST) demonstrated that a process-oriented framework was associated with reductions in substance use, hostility, and emotional dysregulation, alongside improvements in sports performance (Gross et al., 2018) (Table 1). These findings highlight the broader psychological and performance-related benefits of process-focused goal setting.

Building on process-focused regulation, performance goals (Hodges & Williams, 2019; Travassos et al., 2013) are oriented toward self-referenced performance standards and are typically evaluated against an athlete's previous performances. For example, a runner might set a performance goal to complete a 5K race in under 20 minutes. Performance goals provide a clear benchmark for progress, helping athletes stay motivated by seeing measurable improvements in their abilities. Stoeber et al. (Stoeber et al., 2009) conducted two prospective studies involving triathletes (N=112 in Study 1, N=321 in Study 2) to examine the relationship between perfectionism, personal goals, and race performance (Table 1). The studies found that high performance-approach goals and personal goal setting predicted better race performance, while low performance-avoidance goals also contributed. Interestingly, perfectionism did not undermine performance but was linked with goals that helped athletes achieve their best. This demonstrates the importance of performance goals in driving athletes toward continuous improvement without the negative impact of perfectionism.

In contrast to self-referenced performance goals, outcome goals (Miller & Weiss, 2015) emphasise competitive results and social comparison, such as winning or achieving a specific ranking (Forsblom et al., 2019; Gaudreau & Braaten, 2016). While outcome goals can serve as powerful motivators, their effectiveness appears strongly contingent on motivational quality. Using moderated regression analyses in a large sample of undergraduate athletes in Belgium (n=515), Gaudreau and Braaten (2016) showed that mastery-approach and performance-approach goals were associated with better goal attainment when driven by autonomous motivation (Table 1). In contrast, controlled motivation was linked to poorer psychological outcomes, whereas autonomous motivation was positively associated with sport satisfaction and positive affect. These findings highlight that outcome goals can support performance most effectively when embedded within an autonomy-supportive motivational framework.

Goal hierarchies (Gozli & Dolcini, 2018; Van Yperen, 2022), another effective strategy, involve setting a series of goals that build upon each other, starting with basic skills and progressing to more complex objectives. This ensures that athletes develop foundational skills before attempting more challenging tasks, leading to more sustainable and comprehensive performance improvements (Williams & MacNamara, 2022). Van Yperen (Van Yperen, 2022) conducted a survey-based study with 647 participants aged 16-56 years (69.4% women) involved in Korfball in the Netherlands (Table 1). The study explored athletes' use of a hierarchical goal system, where overarching and subordinate goals were examined. The majority of athletes (51.6%) indicated that their primary goal was to win (other-based approach goal), but self-based and task-based approach goals also contributed to competence satisfaction. The study demonstrated that subordinate goals within a hierarchical goal system help athletes self-regulate and maintain focus as they work toward their ultimate goal of winning, highlighting the effectiveness of structured goal hierarchies in sports.

Several strategies enhance the effectiveness of goal setting. One widely used approach is the SMART criteria (Olanescu et al., 2021; Putro et al., 2018), where goals are Specific, Measurable, Achievable, Relevant, and Time-bound. SMART goals are highly effective because they provide clear criteria for success, making it easier for athletes to track their progress and stay motivated (Swann et al., 2020). Additionally, combining short-term and long-term goals allows athletes to experience frequent successes while working towards more significant achievements. Short-term goals provide immediate objectives that can be achieved quickly, while long-term goals require sustained effort over time. This combination maintains motivation and focus. Swann et al. (Swann et al., 2020) conducted a study in Australia with 78 participants (M = 55.88 years) using a repeated measures design to compare different goal-setting approaches during a 6-minute walking test (Table 1). Participants were randomly assigned to one of four

goal conditions: SMART, open, do-your-best, and control. The results showed that open, SMART, and do-your-best goals led to greater distance walked and higher perceived exertion than the control group. Interestingly, while SMART goals led to higher pressure and tension, they also resulted in higher enjoyment alongside open goals, which additionally increased perceptions of performance and interest in repeating the session. This underscores the importance of using SMART goals effectively while balancing motivation and pressure in athletic contexts.

Taken together, the reviewed studies suggest that no single goal type consistently predicts superior performance across sporting contexts. Instead, process, performance, and outcome goals appear to function most effectively when used in combination and adjusted according to situational demands. Across studies, process goals were most consistently linked to attentional control and emotional regulation, performance goals supported self-referenced improvement and motivation, while outcome goals were highly sensitive to motivational orientation and evaluative pressure. These patterns underscore the importance of goal flexibility and integration rather than strict adherence to any single goal framework.

Table 1: Summary of Studies on Goal Setting in Sports

No.	Author(s)/Year/Country	Participants (N=completed/enrolled)/Age Range/Gender	Study Design	Type of Sports	Type of MST	Intervention	Key Findings
	General goal setting						
1.	Gardner et al., 2017, USA	N=86 (MS3 students)/ Age: Not specified/ Mixed gender	Quasi-experimental	Team-based simulation training	General Goal Setting	Group-level vs Individual-level goal setting in team training simulations	Individual goal-setting led to significant improvement in teamwork performance compared to no goal-setting
	Process goals						
2.	Gross et al., 2018, USA	N=18 (female student athletes)/ NCAA Div III/ Age range not specified/ Gender not specified	Randomized Controlled Trial (RCT)	Various (NCAA Division III athletes)	Process Goals - Mindfulness-Acceptance-Commitment (MAC) vs Psychological Skills Training (PST)	Comparison of MAC approach vs traditional PST for improving mental health and sports performance	MAC approach reduced substance use, hostility, and emotion dysregulation more effectively than PST. Improved sports performance from pre- to post-intervention in the MAC group.

N.B: MST = Mental Skills Training; NCAA = National Collegiate Athletic Association Division III

Table 1: (Cont.) Summary of Studies on Goal Setting in Sports

No.	Author(s)/Year/Country	Participants (N=completed/enrolled)/Age Range/Gender	Study Design	Type of Sports	Type of MST	Intervention	Key Findings
	Performance goals						
3.	Stoeber et al., 2009, USA	N=112 in Study 1, N=321 in Study 2/ Triathletes/ Age range not specified/ Gender not specified	Prospective studies	Triathlon	Performance Goals (Performance-approach and performance-avoidance goals)	Examination of how perfectionism and personal goals predict race performance in competitive triathletes	High performance-approach goals and personal goal setting predicted better race performance, while low performance-avoidance goals also contributed. Perfectionism did not undermine performance but was linked with goals aiding athletes in achieving their best.
	Outcome goals						
4.	Gaudreau & Braaten, 2016, Belgium	N=515/ Undergraduate students in sports/ Age range not specified/ Mixed gender	Moderated Regression Analyses	Various (Undergraduate student athletes)	Outcome Goals - Mastery-approach (MAP) and performance-approach goals (PAP)	Examination of the influence of autonomous vs controlled motivation on the outcomes of achievement goals in sports	MAP and PAP goals linked to better goal attainment when driven by autonomous motivation. Autonomous motivation positively associated with sport satisfaction and positive affect, while controlled motivation had negative effects.

N.B: MST = Mental Skills Training

Table 1: (Cont.) Summary of Studies on Goal Setting in Sports

No.	Author(s)/Year/Country	Participants (N=completed/enrolled)/Age Range/Gender	Study Design	Type of Sports	Type of MST	Intervention	Key Findings
	Outcome goals						
5.	Forsblom et al., 2019, Finland	N=146/ Female athletes across 24 teams/ Age range not specified/ Gender not specified	Longitudinal study	Ice hockey, ringette, floorball	Outcome Goals (with process and performance goals included)	Examination of goal setting practices across a season, including outcome, process, and performance goals	Outcome goals were frequently evaluated at the end of the season, while process and performance goals were evaluated less consistently. Lack of consistent follow-through on goal evaluation attributed to too many goals and not writing them down.
	SMART Goals						
6.	Swann, C., Hooper, A., Schweickle, M. J., Peoples, G., Mullan, J., Hutto, D., Allen, M. S., Vella, S. A. (2020) / Australia	N = 78/ Age: Mean = 55.88 years/ Mixed gender	Repeated measures design (mixed model)	Walking	SMART goals, Open goals, Do-your-best goals	Participants were randomly assigned to one of four goal conditions (SMART, open, do-your-best, control) during a 6-minute walking test	Open, SMART, and do-your-best goals led to greater distance walked and perceived exertion than the control. Open and SMART goals resulted in higher enjoyment, but SMART goals also led to higher pressure/tension, while open goals led to higher perceptions of performance and interest in repeating the session

N.B: MST = Mental Skills Training

Table 1: (Cont.) Summary of Studies on Goal Setting in Sports

No.	Author(s)/Year/Country	Participants (N=completed/enrolled)/Age Range/Gender	Study Design	Type of Sports	Type of MST	Intervention	Key Findings
	Hierarchy goals						
7.	Nico W. Van Yperen (2022) / Netherlands	N = 647/ Age range: 16-56 years/ 69.4% women	Survey-based study	Korfball	Hierarchical goal system	Survey data collected on athletes' overarching and subordinate goals	The majority of athletes (51.6%) indicated that their primary goal was to win (other-based approach goal), but self-based and task-based approach goals also contributed to competence satisfaction. Subordinate goals within a hierarchical goal system help athletes self-regulate to reach their ultimate goal of winning.

N.B: MST = Mental Skills Training

Critical Review of Goal Setting

While empirical evidence supports the effectiveness of goal setting in enhancing sports performance, closer examination of the reviewed studies reveals limitations in how traditional goal-setting frameworks are conceptualised and applied across dynamic sporting environments. There is growing evidence that the over-reliance on traditional goal-setting frameworks such as SMART criteria may limit an athlete's cognitive flexibility and long-term adaptability (Healy et al., 2018b). Traditional goal-setting models, such as those emphasized by Olanescu et al. (Olanescu et al., 2021) and Swann et al. (Swann et al., 2020), tend to focus on clear, structured pathways. However, in high-pressure and dynamic environments, particularly in elite sports, this rigidity might lead to psychological burnout when athletes struggle to meet predefined expectations (Giusti et al., 2020).

Process goals, while effective in promoting skill development (Gross et al., 2018), may need refinement in their application to more complex, dynamic sports environments where external variables are constantly in flux. For instance, sports like tennis or soccer involve real-time adjustments to unpredictable game scenarios, and rigid process goals may not always support the rapid decision-making required. A more fluid approach such as adaptive process goal-setting, where athletes revise goals in real-time, could help optimize both cognitive and physical performance in unpredictable settings (Jackman et al., 2024). This introduces a new direction for understanding how athletes mentally navigate chaotic or less predictable environments. Performance goals, often highlighted as critical for tracking personal improvement (Hodges & Williams, 2019; Stoeber et al., 2009), might inadvertently create a tunnel vision effect, where athletes become hyper-focused on metrics rather than holistic skill development. In this context, integrating multi-modal performance assessments, encompassing not just physical metrics but also emotional and psychological variables, could provide a more comprehensive understanding of athlete development (Healy et al., 2018b). Such a shift could pave the way for future mental skills training interventions that prioritize well-rounded performance rather than narrowly defined metrics of success.

Outcome goals (Miller & Weiss, 2015), with their emphasis on external comparisons, might also present risks by fostering a fixed mindset. Athletes driven by external rankings can suffer from diminished intrinsic motivation over time, as success is framed externally rather than internally. Emerging research suggests that athletes who focus less on outcome goals and more on resilience-focused goal setting, which emphasizes personal growth in adversity, may develop a more sustainable motivation system (Westmattelmann et al., 2021).

Critique of the SMART Model

The SMART model (Olanescu et al., 2021) has been widely adopted due to its clear structure. While its clarity and straightforwardness have contributed to its popularity, a critical examination reveals inherent limitations that may hinder its effectiveness in the dynamic context of athletic performance.

One of the primary critiques of the SMART model is its rigidity. The model's emphasis on specificity and measurability can lead to a narrow focus on quantifiable outcomes, potentially sidelining the broader, more qualitative aspects of an athlete's experience. This rigidity can be particularly detrimental in high-stakes environments where adaptability is crucial. Athletes often face unpredictable challenges, such as injuries, changes in competition conditions, or shifts in personal circumstances. In such scenarios, a strict adherence to SMART goals may inhibit an athlete's ability to pivot and recalibrate their objectives in response to these evolving contexts.

In contrast, the CLEAR model, developed by Adam Kreek, an Olympic-level rower, offers a more flexible and holistic approach to goal setting. The CLEAR acronym stands for Collaborative, Limited, Emotional, Appreciable, and Refinable, emphasizing the importance of adaptability, emotional engagement, and collaborative support in the goal-setting process. This model aligns more closely with contemporary

psychological theories of motivation, such as Self-Determination Theory (SDT), which posits that autonomy, competence, and relatedness are essential for fostering intrinsic motivation and psychological well-being (Deci & Ryan, 2012).

The CLEAR model's focus on collaboration acknowledges the social dynamics inherent in sports, where athletes often rely on coaches, teammates, and support networks to achieve their goals. By fostering an environment of shared objectives and mutual support, the CLEAR model enhances the athlete's sense of belonging and motivation, which are critical for sustained engagement and performance. Furthermore, the emotional component of the CLEAR model recognizes that athletes are not merely goal-oriented machines. They are individuals with complex emotional landscapes that can significantly impact their performance and well-being. Another significant advantage of the CLEAR model is its emphasis on refinement. Unlike the SMART model, which often sets fixed goals, the CLEAR model encourages ongoing evaluation and adjustment of goals based on the athlete's experiences and changing circumstances. This iterative process not only fosters resilience but also helps prevent burnout, as athletes can recalibrate their objectives to align with their evolving motivations and circumstances. while the SMART model has provided a foundational framework for goal setting in sports, its rigidity may limit athletes' adaptability and emotional engagement. The CLEAR model offers a more nuanced approach that aligns with modern psychological theories of motivation and resilience. By integrating such innovative models into goal-setting paradigms, coaches and athletes can foster a more supportive and adaptive environment that promotes long-term success and well-being. Incorporating such new models into goal-setting paradigms may offer a way to prevent burnout and sustain long-term athletic success.

The Role of 'Contextual Goals'

The concept of contextual goals in sports psychology is gaining traction as researchers explore how athletes can adapt their objectives based on the dynamic interplay of environmental, physical, and emotional factors. Contextual goals are defined as those that are contingent upon the specific circumstances athletes find themselves in, allowing for a more flexible and responsive approach to goal setting. This flexibility is particularly crucial in high-pressure environments where conditions can change rapidly, necessitating a shift in focus and strategy (Healy et al., 2018b; Smith et al., 2011). Healy et al. (Healy et al., 2018b) emphasize that contextual goals enable athletes to recalibrate their aims in real-time, thus challenging the traditional view that goals should be static and measurable over predetermined periods. Moreover, the importance of aligning goals with personal values and the broader context of an athlete's life cannot be overstated. Oblinger-Peters and Krenn (Oblinger-Peters & Krenn, 2020) argue that when athletes set goals that resonate with their intrinsic motivations and values, they experience a greater sense of purpose and meaning in their sport. This alignment not only enhances performance but also serves as a protective factor against mental health issues.

The application of contextual goals also extends to the social environment surrounding athletes. Holt et al. (Holt et al., 2017) propose that positive relationships with coaches, peers, and family members create a supportive climate that fosters positive youth development through sport. This social context is crucial for the successful implementation of contextual goals, as it provides the necessary support and encouragement for athletes to adapt their objectives in response to changing conditions.

Contextual goals allow for flexibility and recalibration in real time, offering a way for athletes to mentally pivot and adjust their focus as circumstances shift. This approach challenges the traditional notion that goals must be static and measurable over set periods, introducing a more dynamic, real-world applicable concept of goal setting.

Visualization and Imagery

Visualization and imagery are essential mental skills in sports psychology, widely recognized for their effectiveness in enhancing athletic performance. These techniques involve creating vivid mental images of

successful performances, rehearsing specific skills, and envisioning positive outcomes. Athletes use visualization and imagery to mentally simulate the physical execution of movements, which can improve motor skills, boost confidence, and reduce anxiety (Röthlin et al., 2020; Tod et al., 2023).

While visualization and imagery are often used interchangeably, there is a subtle distinction between the two. Visualization specifically refers to the creation of mental pictures or visual representations of an athlete's actions or performance, focusing primarily on the visual aspect of the experience (Ignacio et al., 2017; Ranganathan et al., 2004; Tod et al., 2023). Athletes using visualization may picture themselves executing a skill perfectly or achieving a desired outcome, such as crossing the finish line first or making a successful shot (Blanco-Ariza et al., 2024).

Imagery, on the other hand, is a broader concept that encompasses all sensory experiences. It not only involves visual elements but also incorporates kinesthetic (movement), auditory (sounds), tactile (touch), and even emotional components. For example, an athlete practicing imagery might not only see themselves running but also feel the sensation of their muscles working, hear the crowd's cheers, and experience the emotional thrill of winning. Imagery provides a more holistic rehearsal by engaging multiple senses, which can make mental practice more effective for enhancing performance (Nguyen & Brymer, 2018).

Several techniques are employed in visualization and imagery. One common method is called ‘mental rehearsal’ (Ignacio et al., 2017; Trabelsi et al., 2022), where athletes imagine themselves performing their sport in real-time, focusing on the details of the movements, environment, and sensations. This practice can help athletes prepare for various scenarios, refine their techniques, and enhance their readiness for competition. Another technique involves ‘guided imagery,’ (Nguyen & Brymer, 2018; Tsitsi et al., 2017) where a coach or sports psychologist leads the athlete through a structured visualization session, emphasizing specific aspects of performance, such as maintaining form, executing strategies, or overcoming obstacles.

Empirical studies provide substantial evidence supporting the effectiveness of visualization and imagery in sports (Dana & Gozalzadeh, 2017; Nguyen & Brymer, 2018). Research indicates that these techniques can enhance performance by improving motor skills, increasing confidence, and reducing performance anxiety (Lindsay et al., 2023). For instance, a study by Blanco-Ariza et al. (Blanco-Ariza et al., 2024) in Spain, using a quasi-experimental design was used to investigate the impact of visualization on football performance (Table 2). The study involved 40 male football players aged 19-25, who participated in an 8-week plyometric training program. The experimental group combined visualization tasks with their training, while the control group underwent the same program without visualization. The experimental group showed significant improvements in vertical jump ($p = .047$), speed in 50-meter sprints ($p < .034$), and competitive self-confidence ($p < .017$) compared to the control group. These findings suggest that visualization enhances motor learning, strength, and confidence, reinforcing its value in athletic training. Another study by Yachsie et al. (Billy Yachsie et al., 2023) found that both imagery and meditation practices improved archery accuracy (Table 2). However, imagery practice showed a greater effect on archery accuracy compared to meditation practice. Furthermore, Krivyca et al. (Krivyca et al., 2023) conducted a pedagogical experiment in Ukraine and Poland with 62 children aged 10-11 years, including 22 girls and 40 boys, to examine the effects of visual imagery on volleyball skill acquisition (Table 2). The experimental group (N=28) used visual imagery in the form of cyclograms, schematic kinematic poses of an athlete, while learning overhead pass and forearm pass techniques, whereas the control group (N=30) did not. After 5 weeks and 14 classes, the experimental group demonstrated significant improvement and attained a high level of competence in volleyball skills, while the control group achieved only a sufficient level of competence. This study highlights the effectiveness of visual imagery aids in enhancing the acquisition of sports skills, particularly for young athletes.

There are several theories to explain the underlying mechanism of these effects. Studies have shown that the brain's neural pathways activated during visualization are similar to those engaged during actual

physical performance (Mulder, 2007). This neural overlap suggests that visualization and imagery can help athletes reinforce the motor patterns and strategies they use in competition, leading to better execution and performance (Bernardi et al., 2013). For instance, a study by Fischer et al. (Fischer et al., 2016) found that athletes who used imagery training experienced enhanced neural activation in areas associated with movement and coordination, indicating that mental practice can positively impact physical performance.

In addition to enhancing motor skills and performance, visualization and imagery can also play a crucial role in psychological preparation (Stephen et al., 2022). Athletes who engage in regular visualization and imagery report increased confidence and reduced anxiety before competitions. This psychological benefit is supported by research showing that visualization and imagery can help athletes manage stress and maintain focus under pressure. For example, a study by Mizuguchi et al. (Mizuguchi et al., 2012) found that athletes who used imagery techniques experienced lower levels of pre-competition anxiety and higher levels of self-confidence, contributing to better overall performance.

The accumulated evidence suggests several consistent trends in the application of visualization and imagery across sporting contexts. First, both techniques are most effective when they are task-specific and embedded within physical training rather than used in isolation, supporting improvements in motor execution, confidence, and performance outcomes. Second, imagery approaches that engage multiple sensory modalities tend to produce broader and more robust effects than purely visual rehearsal, particularly for skill acquisition and accuracy-based tasks. Third, the benefits of visualization and imagery extend beyond motor performance to include psychological preparation, with consistent reductions in pre-competitive anxiety and enhancements in self-confidence observed across age groups and sport types. Collectively, these patterns suggest that visualization and imagery function most effectively as integrative tools that simultaneously support motor learning and psychological regulation, rather than as stand-alone mental techniques.

Table 2: Summary of Studies on Visualization and Imagery in Sports

No.	Author(s)/Year/Country	Participants (N=completed/enrolled)/Age Range/Gender	Study Design	Type of Sports	Type of MST	Intervention	Key Findings
	Visualisation						
1.	Vinoth K. Ranganathan et al. (2003) / USA	N = 30 young/ healthy volunteers/ Gender not specified	Randomized controlled trial (RCT)	Not specific to sports; Muscle training (Finger and Elbow)	Mental training (Visualization)	Participants were divided into groups: one performing mental contractions of little finger abduction (N=8), one performing mental contractions of elbow flexion (N=8), and a control group (N=8) for 12 weeks, 15 min/day, 5 days/week. Six volunteers performed training of physical maximal finger abductions.	Mental training increased finger abduction strength by 35% and elbow flexion strength by 13.5%. The physical training group increased finger abduction strength by 53%. No changes in control group. Cortical activity increased as well.

N.B: MST = Mental Skills Training

Table 2: (Cont.) Summary of Studies on Visualization and Imagery in Sports

No.	Author(s)/Year/Country	Participants (N=completed/enrolled)/Age Range/Gender	Study Design	Type of Sports	Type of MST	Intervention	Key Findings
	Visualisation						
2.	Jesús Blanco-Ariza et al. (2024) / Spain	N = 40 male football players/ Aged 19-25 years (Mean = 20.82, SD = 1.26)/ Gender not specified	Quasi-experimental design (pretest-posttest with control group)	Football (Soccer)	Mental Visualization	8-week plyometric training program with visualization tasks for the experimental group, while the control group underwent the same program without visualization tasks.	The experimental group showed significant improvements in vertical jump ($p = .047$), speed (50-m sprints) ($p < .034$), and competitive self-confidence ($p < .017$) compared to the control group. Visualization enhanced motor learning, strength, and confidence.

N.B: MST = Mental Skills Training; SD = Standard Deviation

Table 2: (Cont.) Summary of Studies on Visualization and Imagery in Sports

No.	Author(s)/Year/Country	Participants (N=completed/enrolled)/Age Range/Gender	Study Design	Type of Sports	Type of MST	Intervention	Key Findings
	Imagery						
3.	Betrix Teofa Perkasa Wibafied Billy Yachsie et al. (2023) / Indonesia	N = 24 male athletes/ Age not specified, Gender not specified	Experimental study (two groups pretest-posttest design)	Archery	Imagery and Meditation	Participants were divided into two groups: imagery training group and meditation group, with both groups completing 10 sessions focused on archery accuracy at 40-meter distance.	Both imagery and meditation practices improved archery accuracy. However, imagery practice showed a greater effect on archery accuracy compared to meditation practice.
4.	Iryna Krivyca, Olena Nesen, Yevheniia Strelnykova, Krzysztof Wnorowski (2023) / Ukraine, Poland	N = 62 (28 experimental, 30 control)/ Age = 10-11 years/ 22 girls, 40 boys	Pedagogical experiment (5 weeks, 14 classes)	Volleyball	Visual imagery	Visual imagery using cyclograms (scheme kinematic poses of an athlete) to teach Overhead Pass and Forearm Pass techniques; experimental group used visual aids, control group did not.	Experimental group showed significant improvement and attained a high level of competence in volleyball skills, while the control group achieved only a sufficient level of competence. Visual imagery aids can enhance skill acquisition.

N.B: MST = Mental Skills Training

Critical Review of Visualization and Imagery

Visualization and imagery have long been regarded as foundational mental skills in sports psychology, with substantial empirical support for their role in enhancing athletic performance. However, despite the extensive body of research, there is a need to revisit and expand upon the traditional applications of visualization and imagery techniques to align with contemporary advancements in neuroscience and sports science.

Visualization versus Imagery: A Rigid Dichotomy?

The distinction between visualization and imagery is often drawn based on sensory scope: visualization focuses primarily on mental pictures, whereas imagery encompasses a broader range of sensory inputs, including kinesthetic, auditory, and emotional experiences (Ignacio et al., 2017; Ranganathan et al., 2004). This distinction, while useful in pedagogical settings, may oversimplify the complexity of how athletes mentally rehearse performance. Emerging neurocognitive research suggests that sensory modalities are not distinctly isolated during mental practice but are instead integrated and fluid (Cooper et al., 2014). Research by Cooper et al. (Cooper et al., 2014) discusses the hierarchical multi-route model of action control, highlighting how cognitive processes involved in routine actions are influenced by both top-down (intentional) and bottom-up (environmentally triggered) mechanisms. This model suggests that sensory modalities interact fluidly during the execution of tasks, indicating that mental practice involves a complex interplay of sensory inputs rather than isolated processing. This fluidity is crucial for athletes as it allows them to adapt their mental strategies based on the context of their performance. This calls into question the utility of maintaining such a rigid dichotomy between visualization and imagery in applied practice. Future frameworks should consider the dynamic interplay of sensory experiences in mental rehearsal, advocating for a more holistic approach to mental skills training.

The Neurocognitive Basis of Mental Practice: Beyond Motor Skills

While the majority of studies on visualization and imagery have focused on their benefits to motor skills and performance, recent insights from neuroplasticity suggest that these techniques could extend beyond enhancing motor patterns. For example, imagery has been shown to activate neural circuits involved not only in motor execution but also in cognitive functions such as decision-making, anticipation, and emotional regulation (Bernardi et al., 2013; Fischer et al., 2016; Mulder, 2007). This broad neural activation implies that mental rehearsal could serve as a tool for cognitive adaptability, especially in sports that require quick decision-making and strategic thinking. Challenging the current focus on motor rehearsal, we propose that future research should explore the role of visualization and imagery in cognitive agility and emotional resilience.

Personalized and Context-Specific Imagery

Another limitation in the existing literature is the one-size-fits-all approach to mental skills training. While studies demonstrate the efficacy of guided imagery and mental rehearsal in general, these techniques are often applied uniformly across athletes, neglecting individual differences in cognitive processing, emotional states, and sports contexts (Di Corrado et al., 2019, 2020). Research on individual variability in imagery ability suggests that athletes differ significantly in how vividly they can generate and manipulate mental images, which directly influences the effectiveness of the technique (Di Corrado et al., 2019). The implications of this variability are profound. Athletes who can vividly visualize their performance are likely to experience greater benefits from mental imagery techniques compared to those who struggle with this skill. This discrepancy underscores the necessity for a more personalized approach to mental skills training, where individual cognitive profiles and sport-specific demands inform the development of tailored mental skills programs. Such an approach could enhance the effectiveness of mental training by aligning with the unique psychological and physiological needs of each athlete, ultimately leading to improved performance outcomes and reduced risk of burnout.

We propose that a shift toward more personalized and context-specific imagery training is needed, where individual cognitive profiles and sport-specific demands guide the development of tailored mental skills programs. This approach could enhance the effectiveness of mental training by aligning with the unique psychological and physiological needs of each athlete.

Challenging Conventional Notions of Mental Rehearsal Frequency

A recurring theme in the literature is the assumption that more frequent use of visualization and imagery leads to better outcomes. However, emerging research in cognitive psychology suggests that mental fatigue can impair the efficacy of repeated mental rehearsals, particularly under high-stress conditions (Gavelin et al., 2020; Van Cutsem et al., 2017). Athletes who engage in excessive mental practice may experience diminishing returns, with reduced cognitive flexibility and heightened anxiety as potential side effects. This raises important questions about how mental skills training is prescribed. Should mental rehearsals be periodized, much like physical training, to avoid cognitive overload and maintain mental sharpness? We propose that future studies investigate the optimal frequency and intensity of mental rehearsal sessions to maximize performance without inducing cognitive strain.

Self-talk

Self-talk is a critical mental skill in sports psychology that involves the internal dialogue athletes have with themselves (Latinjak et al., 2014, 2020; Santos-Rosa et al., 2022a; Trabelsi et al., 2022). This dialogue can significantly influence their performance, motivation, and psychological well-being. Self-talk can be either positive or negative, each having distinct effects on an athlete's mindset and performance (Tod et al., 2011). Positive self-talk involves encouraging, affirming, and motivating statements that athletes use to build confidence and focus. Examples of positive self-talk include phrases like 'I can do this,' 'I am well-prepared,' and 'I have the skills to succeed.' Positive self-talk helps athletes maintain a constructive and optimistic mindset, which can enhance their performance by boosting confidence, increasing motivation, and improving concentration. Research indicates that athletes who engage in positive self-talk are better equipped to manage stress, remain focused during competition, and recover from mistakes more effectively (Van Raalte et al., 2017).

Conversely, negative self-talk involves critical, self-doubting, and discouraging statements such as 'I can't do this,' 'I'm not good enough,' or 'I'm going to fail.' Negative self-talk can undermine an athlete's confidence, increase anxiety, and distract from the task at hand, ultimately impairing performance (Santos-Rosa et al., 2022b). Athletes who frequently engage in negative self-talk are more likely to experience performance anxiety, decreased motivation, and lower levels of self-esteem. This negative dialogue can create a vicious cycle, where poor performance reinforces negative thoughts, leading to further declines in performance and well-being.

The impact of self-talk on performance and psychological well-being is well-documented in empirical studies. For instance, a review by Van Raalte et al. (Van Raalte et al., 2017) conclude that athletes who used positive self-talk strategies reported higher levels of self-confidence and improved performance outcomes. The review demonstrated that positive self-talk could enhance focus, increase persistence, and foster a positive mental state, all of which are crucial for athletic success. Further supporting this, Santos-Rosa et al. (Santos-Rosa et al., 2022b) conducted a path analysis with 258 female gymnasts in Spain, aged 14-20 years, to examine the role of spontaneous self-talk (both positive and negative) in rhythmic gymnastics (Table 3). The study assessed pre- and post-competition measures, including self-confidence, anxiety, and performance, while also considering contextual (motivational climate) and personal factors (positivity). The results indicated that positive situational self-talk positively predicted performance, whereas negative self-talk negatively predicted performance. Moreover, a task-involving climate and personal positivity were linked to positive self-talk, while an ego-involving climate was associated with both positive and negative self-talk. This demonstrates the importance of fostering a positive motivational climate and personal outlook to encourage beneficial self-talk habits in athletes.

Walter, Nikoleizig, and Alfermann (Walter et al., 2019) also conducted a randomized controlled trial in Germany with 117 junior sub-elite athletes (55 females, 62 males; mean age = 16 years) across multiple sports (Table 3). Participants were assigned to either short-term (1 week) or long-term (8 weeks) self-talk interventions or a control group, with assessments conducted at three time points (pre-, post-, and follow-up). The study found that self-talk training led to reduced somatic anxiety, increased self-confidence, improved self-efficacy, and better performance ratings. Long-term self-talk interventions were particularly effective in achieving these benefits, further highlighting the impact of consistent self-talk practice on both psychological well-being and athletic performance. Together, these findings emphasize the critical role of self-talk in optimizing performance and maintaining mental health in athletes.

To harness the benefits of self-talk, athletes may use several strategies to cultivate positive self-dialogue and minimize negative self-talk. Techniques such as cognitive restructuring, where athletes learn to challenge and reframe negative thoughts, can be highly effective (Tovares, 2010). Additionally, incorporating positive affirmations and motivational statements into daily routines can help reinforce a constructive mindset (Brooks et al., 2012). Regular practice of these techniques can lead to lasting changes in self-talk patterns, promoting enhanced performance and psychological resilience.

Overall, the reviewed studies demonstrate consistent evidence that self-talk meaningfully influences both performance and psychological regulation in athletes. Across sporting contexts and developmental stages, positive self-talk is reliably associated with higher self-confidence, improved focus, and enhanced performance, whereas negative self-talk is linked to increased anxiety, reduced motivation, and performance impairments. Importantly, the effectiveness of self-talk is not solely determined by its valence but is shaped by contextual and individual factors, including motivational climate, emotional state, and training duration. Interventions that promote sustained and structured self-talk practice, particularly within supportive motivational environments, appear to yield the most robust and enduring benefits. Collectively, these findings highlight self-talk as a dynamic regulatory mechanism that operates at the intersection of cognition, emotion, and performance.

Table 3: Summary of Studies on Self-talk in Sports

No.	Author(s)/Year/Country	Participants (N=completed/enrolled)/Age Range/Gender	Study Design	Type of Sports	Type of MST	Intervention	Key Findings
1.	Francisco J. Santos-Rosa, Carlos Montero-Carretero, Luis Arturo Gómez-Landero, Miquel Torregrossa, Eduardo Cervelló (2022) / Spain	N = 258/ Age = 14-20 years/ Female gymnasts	Path analysis; pre- and post-competition measures	Rhythmic gymnastics	Spontaneous self-talk (positive and negative)	Examined how contextual (motivational climate), personal (positivity), and situational variables (self-talk and pre-competitive anxiety) predicted performance in gymnastics. Measured self-talk pre- and post-competition, including self-confidence and anxiety.	Positive situational self-talk positively predicted performance, while negative self-talk negatively predicted performance. Task-involving climate and positivity were linked to positive self-talk, while ego-involving climate was linked to both positive and negative self-talk in sport.

N.B: MST = Mental Skills Training

Table 3: (Cont.) Summary of Studies on Self-talk in Sports

No.	Author(s)/Year/Country	Participants (N=completed/enrolled)/Age Range/Gender	Study Design	Type of Sports	Type of MST	Intervention	Key Findings
2.	Walter, N., Nikoleizig, L., & Alfermann, D. (2019) / Germany	N = 117/ Age: Mean = 16 years/ 55 females, 62 males	Randomized controlled trial; 3 assessments: pre, post, and follow-up	Multiple sports (junior sub-elite athletes)	Self-talk (ST)	Participants were randomly assigned to short-term (1 week) or long-term (8 weeks) ST intervention, or a control group. Measured competitive anxiety, volitional skills, self-efficacy, and coach performance ratings.	ST training resulted in reduced somatic anxiety, higher self-confidence, improved self-efficacy, and better performance ratings. Long-term training had a more significant effect than short-term training. ST interventions were effective in improving junior athletes' psychological states and performance.

N.B: MST = Mental Skills Training

Critical Review of Self-talk

Self-talk is widely recognized as a pivotal mental skill in sports psychology, shaping athletes' internal dialogue and influencing performance, motivation, and psychological well-being (Latinjak et al., 2014, 2020; Santos-Rosa et al., 2022b; Trabelsi et al., 2022). While previous research has delineated the effects of positive and negative self-talk on performance, this section critically examines these assumptions and introduces novel frameworks for understanding self-talk's multifaceted role in sports.

Challenging Current Thinking on Positive vs. Negative Self-talk

Traditional literature often bifurcates self-talk into positive and negative categories, suggesting clear-cut benefits of the former and detriments of the latter (Van Raalte et al., 2017). However, this dichotomous view oversimplifies the complexities of how self-talk functions in real-world athletic environments. Recent studies, such as those by Latinjak et al. (Latinjak et al., 2020), suggest that the content of self-talk is not always a direct predictor of performance outcomes; instead, context, timing, and individual athlete variability play critical roles.

For example, in high-pressure competitive settings, athletes may engage in what appears to be negative self-talk ('I'm not fast enough today'), but this can serve as a motivational tool to recalibrate their strategy or effort. Thus, negative self-talk should not be viewed solely as detrimental but rather as a nuanced element that can sometimes yield adaptive benefits. This challenges the common assumption that all negative self-talk impairs performance.

Introducing a Functional Perspective on Self-talk

A more nuanced approach is to consider self-talk within a functional framework where the value of the internal dialogue lies not in whether it is positive or negative, but in how it influences the athlete's cognitive and emotional state in the moment. For example, constructive negative self-talk could prompt an athlete to address weaknesses, thereby enhancing performance through increased self-awareness (Kim et al., 2021). Conversely, over-reliance on positive self-talk, especially when not aligned with realistic self-assessment, may create complacency or inflated expectations, ultimately hindering progress.

Perhaps it is best to employ self-talk strategies that emphasize intentionality and flexibility, rather than rigidly categorizing statements as positive or negative. Athletes can benefit from learning to intentionally shift their self-talk to align with situational demands. For instance, in moments of high stress, adopting neutral or task-oriented self-talk may be more beneficial than striving to maintain an overly positive internal dialogue (Walter et al., 2019). Moreover, the flexibility to switch between different types of self-talk, depending on the task, emotional state, or competition phase, can foster greater psychological adaptability, which is crucial for sustained high performance.

Future Directions: Beyond Positive Self-talk as a Panacea

This review challenges the overemphasis on positive self-talk as a universal solution. A deeper understanding of the individualized and situational nature of self-talk interventions is necessary. Future research should focus on developing adaptive self-talk models that consider the athlete's personal history, emotional regulation skills, and competitive environment. Such approaches will likely offer more personalized and effective interventions, moving beyond the simplistic positive-negative dichotomy and acknowledging the fluidity of mental skills in dynamic sports settings.

Concentration and Focus

Concentration and focus (Birrer & Morgan, 2010; Diekfuss et al., 2019; Tedesqui & Glynn, 2013) are essential mental skills in sports, as they enable athletes to maintain attention on relevant tasks and cues, even in the presence of distractions or high-pressure situations. The ability to concentrate effectively can

significantly influence an athlete's performance, decision-making, and overall success. There are several techniques designed to enhance concentration, with mindfulness and meditation (Osborne, 2016) playing a particularly prominent role.

Mindfulness and meditation (Baltzell et al., 2014; Bühlmayer et al., 2017; Noetel et al., 2019) have been shown to play a significant role in enhancing concentration and focus. Mindfulness involves maintaining present-moment awareness and accepting one's thoughts and feelings without judgment (Shapiro et al., 2018). Meditation practices, such as mindful breathing and body scans, can help athletes develop greater control over their attention and reduce the impact of distractions (Rooks et al., 2017). Studies have demonstrated that mindfulness and meditation can improve cognitive function, emotional regulation, and resilience to stress (Hussey et al., 2020), all of which contribute to better concentration and focus.

Empirical evidence supports the effectiveness of mindfulness and meditation in sports. A study by Nien et al. (Nien et al., 2020) found that athletes who engaged in regular mindfulness meditation experienced significant improvements in their ability to concentrate and perform under pressure (Table 4). Nien et al. conducted a quasi-experimental study in Taiwan with 46 university athletes participating in various sports. The athletes were divided into two groups: a mindfulness training (MT) group that underwent a 5-week mindfulness program and a control group on a waiting list. Pre- and post-intervention assessments were conducted to evaluate mindfulness levels, endurance performance (through a graded exercise test), executive functions (using the Stroop task), and N2 event-related potentials (ERPs) to measure neural processes. The results showed that the mindfulness group experienced significant improvements in mindfulness levels, endurance performance, and Stroop task accuracy compared to the control group. Furthermore, the mindfulness group exhibited smaller N2 amplitudes, which suggests reduced conflict monitoring in neural processes. These findings demonstrate that mindfulness training effectively enhances both cognitive and endurance performance in athletes, making it a valuable tool for improving focus and performance in high-pressure sports environments.

Meditation techniques, such as focused attention meditation, is where individuals concentrate on a single point of focus (e.g., their breath or a mantra). This practice trains the mind to return to the chosen point of focus whenever it wanders, building the mental discipline necessary for sustained attention. In a study conducted by Gao and Zhang (Gao & Zhang, 2023), 78 university athletes participated in an experimental design using virtual reality shooting simulations (Table 4). The athletes were randomly divided into two groups: Mindfulness Meditation (MM) and Mind Wandering (MW). Both groups engaged in a 20-minute pre-competition session followed by a VR shooting competition, during which eye-tracking and functional near-infrared spectroscopy (fNIRS) were used to assess attentional control and brain activation. The MM group demonstrated better attentional control, with longer task-relevant fixation durations and fewer task-irrelevant fixations compared to the MW group. Additionally, the MM group exhibited stronger activation of the dorsolateral prefrontal cortex (dlPFC) and greater functional connectivity, which led to improved shooting performance. This study highlights how mindfulness meditation can effectively enhance focus and performance, particularly in closed-skill sports like shooting.

Another effective technique to enhance concentration is the use of pre-performance routines (Mesagno & Mullane-Grant, 2010). These routines involve a series of actions or rituals that athletes perform before engaging in their sport, helping them transition into a focused state (Rupprecht et al., 2024). Mesagno and Mullane-Grant (2010) conducted an experimental study with 60 experienced Australian football players to examine the effectiveness of pre-performance routines (PPR) under high-pressure conditions (Table 4). Participants were divided into five groups: four intervention groups that received training on specific aspects of PPR and one control group that did not receive any training. All participants were tested under low- and high-pressure conditions, with state anxiety levels measured throughout. The results showed that anxiety increased during the high-pressure phase for all participants, but those in the intervention groups were able to improve their performance despite the pressure, while the control group showed decreased performance. The study concluded that a non-automated PPR, incorporating both psychological and

behavioral components, helped athletes alleviate choking and maintain performance under pressure. This demonstrates the value of well-structured pre-performance routines in helping athletes maintain focus and perform optimally in high-pressure environments.

Another technique is the practice of goal-directed attention (Latinjak et al., 2014), where athletes learn to concentrate on specific performance-related cues while ignoring irrelevant stimuli. This can involve focusing on the feel of the bat in their hands, the sound of the ball hitting the racket, or the visual target of the goal. By directing their attention to these specific elements, athletes can improve their concentration and execution of skills. Mulvenna et al. (Mulvenna et al., 2020) conducted a repeated measures experimental study in the UK with 114 novice basketball players (mean age = 23.53 years, SD = 4.56) to examine the effects of approach-based achievement goals in different motivational contexts on performance and psycho-physiological responses (Table 4). Participants were randomly assigned to one of six experimental conditions based on goal type (task-approach, self-approach, or other-approach) and motivational context (autonomy-supportive or controlling). The study measured heart rate (HR), blood pressure (BP), stress, anxiety, task enjoyment, competence, and goal attainment. The results showed that participants in a controlling context had higher HR and BP, and those in the other-approach goal group exhibited higher diastolic BP. Task-approach goals under controlling conditions increased threat perception, while approach-based goals in an autonomy-supportive context improved performance. Although the study provided limited support for the integrated motivational model, it highlighted the importance of goal-directed attention and the role of motivational contexts in performance outcomes. These findings underscore the value of integrating goal-directed attention training into practice to enhance athletic performance under varying conditions.

In aggregate, the reviewed studies indicate that concentration and focus are most effectively enhanced through interventions that combine attentional control with emotional and physiological regulation. Across sport types, mindfulness and meditation-based approaches consistently support improvements in sustained attention, executive control, and performance under pressure, particularly when attentional demands are stable and task structures are well-defined. Complementary strategies such as pre-performance routines and goal-directed attention further contribute to performance consistency by helping athletes manage anxiety and selectively attend to task-relevant cues. Importantly, the effectiveness of these techniques appears contingent on motivational context, with autonomy-supportive environments facilitating more adaptive attentional engagement than controlling conditions. Collectively, these findings suggest that concentration training is most effective when it integrates attentional, emotional, and contextual components rather than relying on singular techniques.

Table 4: Summary of Studies on Concentration and Focus in Sports

No.	Author(s)/Year/Country	Participants (N=completed/enrolled)/Age Range/Gender	Study Design	Type of Sports	Type of MST	Intervention	Key Findings
1.	Jui-Ti Nien, Chih-Han Wu, Kao-Teng Yang, Yu-Min Cho, Chien-Heng Chu, Yu-Kai Chang, Chenglin Zhou (2020) / Taiwan	N=46 university athletes/ Aged 18-25 years old/ Intervention group (n = 23; 16 males, 7 females) or the control group (n = 23; 18 males, 5 females)	Quasi-experimental design with pre- and post-intervention assessments	Multiple sports (university athletes)	Mindfulness Training (MT)	Participants were divided into two groups: a mindfulness group that underwent a 5-week mindfulness training program and a control group on a waiting list. The mindfulness group was evaluated for mindfulness levels, endurance performance (graded exercise test), executive functions (Stroop task), and N2 event-related potentials (ERPs).	The mindfulness group showed significant improvements in mindfulness levels, endurance performance, and Stroop task accuracy compared to the control group. The group also exhibited smaller N2 amplitudes, suggesting reduced conflict monitoring in neural processes. Mindfulness training was effective in enhancing cognitive and endurance performance in athletes.

N.B: MST = Mental Skills Training

Table 4: (Cont.) Summary of Studies on Concentration and Focus in Sports

No.	Author(s)/Year/Country	Participants (N=completed/enrolled)/Age Range/Gender	Study Design	Type of Sports	Type of MST	Intervention	Key Findings
2.	Qian Gao, Liwei Zhang (2023) / China	N=76/ 78 university athletes/ Age: Mean = 20.68 years, SD = 4.77/ MM group (n = 40; 21 males) or the MW group (n = 36; 19 males).	Experimental design with virtual reality simulation	Virtual reality shooting	Brief Mindfulness Meditation	Participants were randomly divided into two groups: MM and MW. Both groups engaged in a 20-minute pre-competition session followed by a VR shooting competition. Eye-tracking and functional near-infrared spectroscopy (fNIRS) were used to assess attentional control and brain activation.	The MM group showed better attentional control, longer task-relevant fixation durations, and fewer task-irrelevant fixations compared to the MW group. Additionally, the MM group exhibited stronger activation of the dlPFC and greater functional connectivity, leading to improved shooting performance. Mindfulness meditation effectively enhanced focus and performance in closed-skill sports.

N.B: MST = Mental Skills Training; SD = Standard Deviation; MM = Mindfulness Meditation; MW = Mind Wandering; VR = Virtual Reality; dlPFC = dorsolateral prefrontal cortex

Table 4: (Cont.) Summary of Studies on Concentration and Focus in Sports

No.	Author(s)/Year/Country	Participants (N=completed/enrolled)/Age Range/Gender	Study Design	Type of Sports	Type of MST	Intervention	Key Findings
3.	Christopher Mesagno, Thomas Mullane-Grant (2010) / Australia	N=60 experienced Australian football players/ Age not specified/ Gender not specified	Experimental design with low- and high-pressure conditions	Australian football	Pre-Performance Routine (PPR)	Participants were assigned to one of five groups (four intervention groups and one pressure control group). The intervention groups received training on specific aspects of PPR before performing under high-pressure conditions, while the control group received no training.	State anxiety increased during the high-pressure phase for all participants. Intervention groups improved performance despite the pressure, while the control group showed decreased performance. A non-automated PPR with psychological and behavioral components helped alleviate choking and improved performance under pressure.

N.B: MST = Mental Skills Training

Table 4: (Cont.) Summary of Studies on Concentration and Focus in Sports

No.	Author(s)/Year/Country	Participants (N=completed/enrolled)/Age Range/Gender	Study Design	Type of Sports	Type of MST	Intervention	Key Findings
4.	Mairi Mulvenna, James Adie, Luke Sage, Nigel Wilson, Douglas Howat (2020) / UK	N=114 novice basketball players / Age: Mean = 23.53 years, SD = 4.56/ Male: n=62, Female: n= 52	Repeated measures experimental design	Basketball	Approach-based Achievement Goals	Participants were randomly assigned to one of six experimental conditions based on goal type (task-/self-/other-approach) and motivational context (autonomy-supportive/controlling). Psycho-physiological measures (HR, BP) and psychological data (stress, anxiety, task enjoyment, competence, and goal attainment) were collected.	Participants in a controlling context had higher HR and BP. Other-approach goal group had higher diastolic BP. Task-approach goals under controlling conditions increased threat perception. Approach-based goals under autonomy-supportive context improved performance. Study provided limited support for the integrated motivational model.

N.B: MST = Mental Skills Training; HR = Heart Rate; BP = Blood Pressure

Critical Review of Concentration and Focus

Concentration and focus are undeniably foundational mental skills for athletic success, with research demonstrating their direct influence on performance outcomes (Birrer & Morgan, 2010; Diekfuss et al., 2019). However, traditional views on concentration often oversimplify this skill as merely the ability to 'focus on the task at hand.' Contemporary research suggests that the mechanisms behind concentration are far more complex and dynamic, requiring a nuanced understanding of attentional flexibility, selective attention, and emotional regulation (Tedesqui & Glynn, 2013).

Challenging the Generalized Approach to Mindfulness in Sports

Mindfulness and meditation are frequently championed as effective strategies for enhancing concentration in athletes (Baltzell et al., 2014; Bühlmayer et al., 2017; Noetel et al., 2019). While empirical evidence supports these practices (Nien et al., 2020), a critical examination reveals that the current application of mindfulness in sports psychology may not be universally beneficial for all athletes or sports contexts. For example, mindfulness, which encourages non-judgmental awareness and acceptance of one's thoughts, might paradoxically limit the sharp, outcome-driven focus necessary in certain high-stakes, high-intensity sports environments, where precision and rapid decision-making are paramount (e.g., sprinting or combat sports) (Perkins et al., 2001).

Recent findings indicate that for athletes engaged in sports requiring quick, reaction-based performance, such as basketball or fencing, mindfulness techniques may inadvertently slow down cognitive processing due to the intentional 'pause' and introspection embedded in the practice (Hussey et al., 2020). This raises the question: should mindfulness techniques be more tailored to specific sports, rather than being broadly prescribed as universally effective?

Revisiting Pre-Performance Routines: Ritual or Cognitive Crutch?

Pre-performance routines have long been recognized as effective tools for maintaining concentration under pressure, helping athletes to enter a focused 'performance state' (Mesagno & Mullane-Grant, 2010). However, emerging research has begun to question the long-term impact of relying too heavily on these routines. While rituals can facilitate focus by acting as cues to enter a performance state (Rupprecht et al., 2024), there is a risk that athletes may develop psychological dependence on these routines. When athletes are unable to complete their routine due to external factors such as time constraints or environmental disruptions, performance may suffer significantly, suggesting that over-reliance on such rituals could hinder adaptability. Research by Yun et al. (Yun et al., 2023) further elucidates the dual nature of ritualized behavior in sports, highlighting both its benefits and drawbacks. While rituals can enhance self-control and focus, they may also lead to compulsive actions that detract from an athlete's ability to respond to the immediate demands of competition. This underscores the need for a balanced approach that incorporates the benefits of pre-performance routines while fostering cognitive flexibility and adaptability.

Future research should focus on developing frameworks that allow athletes to balance the use of routines with cognitive flexibility. This could involve training athletes to recognize when to rely on their routines and when to adapt their strategies based on situational demands. A critical avenue for future research should explore how athletes can balance the use of routines with cognitive flexibility, ensuring they are not psychologically 'locked' into these rituals at the expense of spontaneous adaptability during competition.

Goal-Directed Attention: Enhancing Flexibility in Focus

The technique of goal-directed attention, focusing on task-relevant stimuli while ignoring distractions, remains a cornerstone of concentration training (Mulvenna et al., 2020). However, this too requires refinement. Current training methods often emphasize sustained focus on physical cues (e.g., the feel of the ball, the target), but they may overlook the importance of cognitive and emotional flexibility in maintaining concentration under pressure. Attentional flexibility, defined as the ability to shift focus between different types of stimuli, may enhance an athlete's performance in fast-paced, unpredictable environments. For

instance, during a match, an athlete may need to transition from focusing on body sensations, such as fatigue or tension, to processing tactical information, such as the movements of opponents or teammates. Training that incorporates both goal-directed and dynamic attention strategies could empower athletes to navigate these transitions more effectively, ultimately improving their adaptability and decision-making under pressure.

Moreover, the incorporation of situational drills that simulate the unpredictability of competition can further enhance attentional flexibility. By exposing athletes to varied scenarios that require rapid shifts in focus, coaches can help them practice the cognitive transitions necessary for success in real-world contexts. This approach not only reinforces the importance of goal-directed attention but also emphasizes the need for athletes to be adaptable and responsive to the dynamic nature of their sport. While goal-directed attention remains a cornerstone of concentration training, there is a pressing need to refine current methodologies to incorporate cognitive and emotional flexibility. By training athletes to employ both goal-directed and dynamic attention strategies, practitioners can enhance their ability to shift focus rapidly between different types of stimuli. This attentional flexibility is likely to prove more effective in fast-paced, unpredictable environments, ultimately leading to improved performance outcomes.

Arousal Regulation

Arousal regulation (Durand-Bush et al., 2023; Makepeace et al., 2021; Sammy et al., 2017) is a crucial aspect of sports psychology, as it involves managing an athlete's physiological and psychological states to achieve an optimal level of arousal for peak performance (Perkins et al., 2001). The ability to regulate arousal can significantly impact an athlete's performance, influencing factors such as focus (Abdollahipour et al., 2015; Saemi et al., 2023), coordination (Hoyle et al., 2020), and decision-making (Ashford et al., 2021; Natsuhara et al., 2020). Various methods can be employed to manage arousal levels, including relaxation techniques (Jermaina et al., 2022) and biofeedback (Shokri & Nosratabadi, 2021), each playing a pivotal role in helping athletes maintain the ideal arousal state.

Relaxation techniques (Battaglini et al., 2022; Parnabas et al., 2014; Renaghan et al., 2023; Toussaint et al., 2021) are commonly used to reduce excessive arousal and promote a calm and focused state of mind. These techniques include progressive muscle relaxation (PMR) (Liang et al., 2021), deep breathing exercises (Anderson & Bliven, 2017; Migliaccio et al., 2023), and visualization (Lin et al., 2021; Ridderinkhof & Brass, 2015). Progressive muscle relaxation involves systematically tensing and then relaxing different muscle groups, which can help reduce physical tension and promote relaxation (Pagani et al., 2023). Deep breathing exercises, such as diaphragmatic breathing, focus on slow, deep breaths to activate the parasympathetic nervous system, which counteracts the body's stress response and induces a state of calm (Gholamrezaei et al., 2021). Visualization, or mental imagery, allows athletes to create mental pictures of relaxing scenes or successful performances, helping to reduce anxiety and enhance confidence (Lin et al., 2021).

One of the oldest studies on arousal regulation, Perkins, Wilson, and Kerr (Perkins et al., 2001) conducted an experimental study with 28 elite athletes (22 males, 6 females) in the USA to investigate the effects of guided imagery and paced breathing on performance under different arousal conditions (Table 5). The athletes were induced into two motivational states: high arousal telic (goal-directed) and high arousal paratelic (process-focused). Guided imagery and paced breathing techniques were used to manipulate psychological and physiological arousal. Participants were then tested on a hand strength task. The results showed that significant increases in strength performance occurred when arousal was high and experienced as pleasant excitement in the paratelic condition (high positive arousal). Interestingly, heart rate and other indicators of parasympathetic and sympathetic nervous system activity did not mediate between psychological arousal and performance. This study suggests that high arousal, when experienced positively, can enhance maximal strength performance, highlighting the importance of using relaxation techniques like guided imagery and paced breathing to optimize athletes' psychological states for peak performance.

Biofeedback (Göçmen et al., 2023; Levy & Baldwin, 2019; Paul & Garg, 2012) is another effective method for managing arousal levels. Biofeedback involves using electronic monitoring devices to provide real-time feedback on physiological processes such as heart rate, muscle tension, and skin conductivity (Chen et al., 2022; Pronczuk et al., 2023). By becoming aware of these physiological responses, athletes can learn to control them through various techniques, such as deep breathing or visualization. Biofeedback training can help athletes achieve a more relaxed state, improve focus, and enhance their ability to perform under pressure. A study by Pusenjak et al. (Pusenjak et al., 2015) in Slovenia examined the effects of biofeedback training on 39 athletes (18 in the experimental group and 21 in the control group), aged 16-34, from various sports disciplines (Table 5). The experimental group, consisting of 4 women and 14 men, underwent 8 weeks of biofeedback training using the Nexus 10 biofeedback device. The training focused on psychophysiological parameters, including respiration, heart rate (HR), skin conductance, and heart rate variability (HRV). Both groups completed stress tests before and after the training period, and a follow-up survey was conducted one year later to assess the long-term usage and benefits of biofeedback skills. The results showed significant improvements in the experimental group in controlling psychophysiological parameters such as galvanic skin response (GSR) and heart rate during stress tests ($p < 0.05$). One year later, participants in the experimental group continued using biofeedback skills, reporting enhanced athletic performance and general well-being. This study highlights the long-term benefits of biofeedback training for managing stress and improving athletic performance.

The impact of arousal regulation on performance is well-documented in sports psychology literature (Forgas et al., 2011; Lișteа et al., 2017). Optimal arousal levels are critical for peak performance, as both under-arousal and over-arousal can hinder an athlete's abilities (Hrozanova et al., 2019). Under-arousal can lead to a lack of motivation, sluggishness, and reduced focus (Swettenham et al., 2020), while over-arousal can cause excessive tension, anxiety, and impaired decision-making (Egeland et al., 2023). Arousal regulation techniques help athletes find the balance between these extremes, enabling them to perform at their best (Turner & Jones, 2018).

Based on the available evidence, effective arousal regulation appears to not be defined by universally lowering arousal, but by achieving a functional balance that aligns physiological and psychological states with task demands. Across sports and performance contexts, relaxation-based strategies and biofeedback interventions consistently support improvements in stress management, attentional stability, and performance under pressure. Importantly, evidence indicates that both low and high arousal states can be performance-enhancing when appropriately regulated and experienced as psychologically positive. The effectiveness of arousal regulation techniques therefore appears contingent on athletes' ability to interpret and modulate arousal states rather than simply suppress them. Collectively, these findings suggest that arousal regulation functions most effectively as a flexible, context-sensitive process rather than a fixed set of calming techniques.

Table 5: Summary of Studies on Arousal Regulation in Sports

No.	Author(s)/Year/Country	Participants (N=completed/enrolled)/Age Range/Gender	Study Design	Type of Sports	Type of MST	Intervention	Key Findings
1.	Doug Perkins, George V. Wilson, John H. Kerr (2001) / USA	N=28 Elite athletes/ Aged: 16–39 yrs/ 22 males, 6 females)	Experimental design	Various sports	Guided imagery and paced breathing	Participants were induced into two motivational states: high arousal telic (goal-directed) and high arousal paratelic (process-focused). Guided imagery and paced breathing were used to manipulate psychological and physiological arousal. Tested on hand strength task.	Significant increases in strength performance occurred when arousal was high and experienced as pleasant excitement in the paratelic condition (high positive arousal). Heart rate and other indicators of parasympathetic and sympathetic nervous system activity did not mediate between psychological arousal and performance. High arousal can enhance maximal strength performance.

N.B: MST = Mental Skills Training

Table 5: (Cont.) Summary of Studies on Arousal Regulation in Sports

No.	Author(s)/Year/Country	Participants (N=completed/enrolled)/Age Range/Gender	Study Design	Type of Sports	Type of MST	Intervention	Key Findings
2.	Eric Renaghan, Michael Joseph Wishon, Harrison L. Wittels, Luis A. Feigenbaum, Kyle Bellamy, Michael Hatfield, Joe Girardi, et al. (2023) / USA	N=38 Division-I collegiate football athletes / Aged range: 18 and 23 years/ Male	Cross-sectional, pre-post experimental design	Football	Mindfulness and Rest techniques	Participants were divided into three groups: mindfulness (15 min guided breathing and body scans), rest (seated restful activities like talking), and no-intervention (usual post-training activities like showering). HR, RR, and HRV indices (SDNN, rMSSD) were measured pre and post-intervention.	Mindfulness and rest groups showed significant reductions in HR and RR compared to the no-intervention group. Mindfulness led to greater reductions in HR and RR and higher post-intervention HRV indices than rest. Both mindfulness and rest may promote PNS reactivation, improving recovery post-training. Longitudinal studies are recommended.

NB: MST = Mental Skills Training; HR = Heart Rate; RR = Respiration Rate; HRV = Hear Rate Variability; SDNN = Standard Deviation of the N-N Intervals; rMSSD = root Mean Square of Successive RR Interval Differences; PNS = parasympathetic nervous system

Table 5: (Cont.) Summary of Studies on Arousal Regulation in Sports

No.	Author(s)/Year/Country	Participants (N=completed/enrolled)/Age Range/Gender	Study Design	Type of Sports	Type of MST	Intervention	Key Findings
3.	Prończuk, M., Trybek, G., Terbalyan, A., Markowski, J., Pilch, J., Krzysztofik, M., Kostrzewa, M., Mostowik, A., & Maszczyk, A (2023)/ Poland	N = 24 athletes from the National team of Polish Judo Association / Aged between 22 and 25 years/ Male	Experimental design [experimental (n = 12) and control (n = 12)].	Judo	EEG Biofeedback Training	Experimental group: 15 EEG biofeedback training sessions over four cycles, with 4-week breaks in between. Reaction times measured using simple and complex reaction time tests and Vienna Test System (VTS).	Significant improvements in visual reaction times (simple and complex tasks) in the experimental group, particularly in complex tasks. No significant changes observed in the control group.

NB: MST = Mental Skills Training; EEG = Electroencephalography

Table 5: (Cont.) Summary of Studies on Arousal Regulation in Sports

No.	Author(s)/Year/Country	Participants (N=completed/enrolled)/Age Range/Gender	Study Design	Type of Sports	Type of MST	Intervention	Key Findings
4.	Nika Pusenjak, Anton Grad, Matej Tusak, Matevz Leskovsek, Romina Schwarzlin (2015) / Slovenia	N=39 athletes (n=18 experimental, n= 21 control) / Age range 16-34 / 4 women, 14 men in experimental group	Experimental design	Various sports disciplines	Biofeedback training	The experimental group underwent 8 weeks of biofeedback training using the Nexus 10 biofeedback device, focusing on psychophysiological parameters such as respiration, heart rate, skin conductance, and heart rate variability. Both groups completed stress tests before and after the training period. A follow-up survey was conducted one year later to assess long-term usage and benefits of biofeedback skills.	Significant improvements in the experimental group in controlling psychophysiological parameters, such as galvanic skin response (GSR) and heart rate (HR) during stress tests ($p < 0.05$). One year later, participants in the experimental group continued using biofeedback skills, reporting enhanced athletic performance and general well-being.

NB: MST = Mental Skills Training

Critical Review of Arousal Regulation

Arousal regulation plays a pivotal role in optimizing sports performance by managing physiological and psychological states to achieve optimal arousal levels. However, a critical analysis of existing literature reveals the dual-edged nature of arousal. While most studies emphasize the need for arousal modulation (Soumendra Saha et al., 2005), the depth of individual differences in arousal thresholds remains under-explored. Current methods for regulating arousal, such as relaxation techniques (Battaglini et al., 2022; Parnabas et al., 2014) and biofeedback (Levy & Baldwin, 2019), have been widely accepted, yet the mechanistic pathways by which they influence both mental and physical performance are often generalized, ignoring sport-specific and individual variability.

Reevaluating the Efficacy of Relaxation Techniques

Relaxation techniques, including PMR, deep breathing exercises, and visualization, have consistently shown efficacy in reducing excessive arousal. However, their effectiveness may be highly contextual, varying between endurance-based and precision sports. Progressive muscle relaxation, by systematically reducing physical tension, supports sports requiring explosive power but may not offer the same cognitive relief in sports like chess, where fine-tuned mental acuity dominates. Similarly, deep breathing's parasympathetic activation (Gholamrezaei et al., 2021) excels in sports demanding sustained focus, such as shooting, but its utility in dynamic sports like football may need re-evaluation.

The generalization of relaxation techniques across various sports may overlook how athletes in different disciplines experience and regulate arousal. For instance, visualization techniques have been explored more rigorously in individual sports (Di Corrado et al., 2019) than team-based contexts, where group dynamics and external stimuli complicate arousal modulation. Research by Vitali et al. (Vitali et al., 2019) supports the notion that the effectiveness of attentional strategies, including relaxation techniques, can vary based on the specific demands of the sport. Their findings indicate that both internal and external focus of attention can be equally effective in endurance sports, suggesting that the context in which relaxation techniques are applied is crucial for their success. This highlights the importance of tailoring relaxation interventions to the specific needs of athletes based on their sport and individual characteristics.

Furthermore, the exploration of relaxation techniques in the context of team dynamics is essential. Team sports often require athletes to manage not only their own arousal levels but also those of their teammates. This interplay can significantly influence the overall effectiveness of relaxation techniques, as athletes must navigate the collective emotional landscape of the team. Understanding how relaxation techniques can be adapted to enhance group cohesion and performance in team settings is a critical area for future research.

While relaxation techniques have demonstrated efficacy in reducing excessive arousal, their effectiveness is highly contextual and may vary between different sports and individual athletes. Future research should focus on developing a more nuanced understanding of how these techniques can be tailored to meet the specific demands of various sports, taking into account the unique experiences of athletes in both individual and team contexts. By doing so, practitioners can enhance the effectiveness of relaxation interventions, ultimately leading to improved performance outcomes.

Biofeedback Under Scrutiny

Biofeedback has gained significant attention in recent years for its ability to provide real-time feedback on physiological markers such as heart rate, muscle tension, and skin temperature (Chen et al., 2022). This technology has been deemed as a promising tool for athletes seeking to enhance their performance by gaining greater control over their physiological states. However, the practical application of biofeedback in high-pressure competitive scenarios remains under-studied, raising important questions about its efficacy as a standalone arousal regulation technique.

One of the primary concerns regarding biofeedback is its feasibility for real-time adjustments during competition. While athletes may train with biofeedback tools to learn how to regulate their physiological responses, the dynamic nature of competitive sports often presents challenges that make immediate adjustments difficult. For instance, during a match, an athlete may experience heightened arousal due to external pressures, such as the score, time constraints, or the presence of opponents. In such situations, the ability to implement biofeedback insights may be compromised, leading to doubts about the validity of biofeedback as a reliable method for arousal regulation in high-stakes environments.

Furthermore, the reliance on biofeedback equipment during training raises concerns about accessibility and equity in sports. Athletes in less resourced settings may not have access to the necessary technology, potentially widening the gap between elite and amateur athletes in terms of arousal regulation training. This disparity can hinder the development of effective mental skills across different levels of competition, as access to advanced training tools becomes a determining factor in an athlete's ability to manage arousal effectively. To address these challenges, further exploration is required to integrate biofeedback training with comprehensive mental skills programs. By combining biofeedback insights with traditional mental training techniques, such as visualization, self-talk, and relaxation strategies, athletes may be better equipped to leverage biofeedback under real-world pressures. This integrated approach could enhance the overall effectiveness of arousal regulation training, allowing athletes to adapt their physiological responses more fluidly during competition.

Moreover, research should focus on developing practical guidelines for the application of biofeedback in competitive settings. This includes investigating how athletes can effectively transition from training environments, where biofeedback is utilized, to competitive scenarios where immediate physiological adjustments are necessary. Understanding the cognitive and emotional factors that influence an athlete's ability to apply biofeedback insights during competition will be crucial for optimizing its use as an arousal regulation technique.

Biofeedback presents a promising avenue for enhancing athletes' control over their physiological states. However, its practical application in competitive environments requires further scrutiny. By addressing the challenges associated with real-time adjustments, accessibility, and integration with mental skills training, researchers and practitioners can work towards developing more effective arousal regulation strategies that benefit athletes across various levels of competition.

Challenging Current Thinking of Arousal Regulation

While arousal regulation is widely accepted as fundamental to sports performance, we challenge the current binary view of arousal as either ‘too much’ or ‘too little.’ Emerging trends suggest a more fluid interaction between cognitive and physical arousal states. For example, athletes in extreme sports (like climbing or motorsports) often thrive in what conventional models would deem an over-aroused state, suggesting a need for recalibrating our understanding of optimal arousal thresholds. Additionally, the interaction between arousal and sport-specific cognitive demands requires further examination, as decision-making under pressure may benefit from higher arousal in fast-paced, dynamic sports.

To advance the field, future research should emphasize a more personalized approach to arousal regulation, considering individual baseline arousal levels, sport-specific requirements, and the dynamic nature of competitions.

Challenges and Gaps in the Literature

Despite the extensive body of research on MST, several gaps remain in the current literature. One significant limitation is the lack of longitudinal studies. While numerous cross-sectional studies validate the immediate effects of MST, there is a relative scarcity of research examining the long-term impact of mental skills training. Few studies track the sustained effects of MST on both performance and psychological well-being over extended periods. This gap limits the understanding of how consistent MST

practice influences athletes over time, particularly in elite or professional settings, where long-term performance enhancements and psychological resilience are critical.

Another challenge is the contextual differences across different types of sports. MST research has predominantly focused on individual sports such as tennis, golf, and track and field, which often have different psychological demands compared to team sports. The unique dynamics and mental demands of team-based sports are underrepresented in the literature. More research is needed to explore how MST interventions can be effectively applied within team contexts and how mental skills training can be optimized for team cohesion and collective performance.

Lastly, there is a lack of diversity in the athlete populations studied. Much of the MST research has concentrated on elite, able-bodied athletes, with fewer studies exploring its application for athletes with disabilities, amateur athletes, or those from diverse cultural backgrounds. Particularly in non-Western contexts, there is a need for more studies to examine how cultural differences may impact the efficacy of MST interventions. Research indicates that athletes with disabilities experience unique psychological and physiological challenges that may influence their response to MST techniques. For example, athletes with disabilities often face heightened stress and anxiety levels, which can affect their performance and mental well-being. Therefore, it is essential to investigate how MST can be tailored to meet the specific needs of this population, ensuring that interventions are both effective and relevant.

Furthermore, the cultural context in which athletes train and compete plays a crucial role in shaping their experiences and perceptions of mental skills training. In many non-Western cultures, traditional beliefs and values may influence how athletes approach mental training and arousal regulation. For instance, collectivist cultures may prioritize group harmony and social support, which could affect the implementation and effectiveness of individual-focused MST interventions. Thus, there is a pressing need for more studies that examine how cultural differences impact the efficacy of MST across diverse athlete populations.

Additionally, the existing literature often overlooks the experiences of amateur athletes who may not have access to the same resources and support systems as elite athletes. Understanding these unique experiences is vital for developing inclusive MST programs that cater to a broader range of athletes. To address these gaps, future research should prioritize the inclusion of diverse athlete populations in MST studies. This includes exploring the effectiveness of MST interventions for athletes with disabilities, amateur athletes, and those from various cultural backgrounds. By doing so, researchers can develop a more comprehensive understanding of MST's potential across all athlete populations, ultimately leading to more effective and inclusive mental training programs

CONCLUSION

This critical review highlights that while mental skills training remains a cornerstone of sport psychology, its effectiveness cannot be fully understood through rigid, one-size-fits-all frameworks. Across the reviewed studies, MST techniques such as goal setting, visualization and imagery, self-talk, concentration, and arousal regulation were associated with meaningful performance and psychological benefits. However, these benefits were highly dependent on contextual factors including sport type, performance demands, athlete characteristics, and implementation strategies.

Collectively, the findings challenge the continued reliance on prescriptive models of MST, such as rigid goal-setting structures or universally applied mindfulness and self-talk interventions. Instead, the evidence supports a shift toward adaptive, flexible, and context-sensitive approaches that prioritise individual differences and situational demands. For researchers, this underscores the need to move beyond binary classifications (e.g., positive versus negative self-talk) and to examine how timing, dosage, and contextual alignment influence MST effectiveness. For practitioners, the findings emphasise the importance of

tailoring mental skills interventions to the athlete's competitive environment, developmental stage, and psychological profile, rather than applying standardised techniques indiscriminately.

By reframing MST as a dynamic regulatory system rather than a static set of techniques, this review contributes to advancing contemporary understanding of mental skills training and offers a conceptual foundation for more responsive, athlete-centred approaches in future research and applied practice.

AUTHORS' CONTRIBUTION

Weijie Huang [WH]: Conceptualization, methodology, data curation, writing - original draft preparation; Nurdiana Zainol Abidin [NZA]: Conceptualization, methodology, data curation, supervision, writing - reviewing and editing; Nor Shuhada Mansor [NSM]: Validation, reviewing and editing; Hazwani Ahmad Yusof [HAY]: Validation, reviewing; Lian Bizhen [LB]: Validation, reviewing.

CONFLICT OF INTEREST

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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