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Do cognitive training strategies improve motor and positive psychological skills development in soccer players? Insights from a systematic review

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Do cognitive training strategies improve motor and positive psychological skills development in soccer players? Insights from a systematic review

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Running Head: Cognitive training and motor and positive psychological skills development in soccer players.

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Abstract

Soccer players are required to have well-developed physical, technical and cognitive abilities. The present systematic review, adhering to Preferred Reporting Items for Systematic reviews and Meta-Analysis (PRISMA) guidelines, examined the effects of cognitive training strategies on motor and positive psychological skills development in soccer performance and identified the potential moderators of the "cognitive training-soccer performance" relationship. Thirteen databases were systematically searched using keywords related to psychological or cognitive training in soccer players. The review is based on 18 studies, employing 584 soccer players aged 7-39 years. Cognitive strategies, particularly imagery, appear to improve sports performance in soccer players. Regarding imagery, the combination of two different types of cognitive imagery training (i.e., cognitive general and cognitive specific) have a positive influence on soccer performance during training, whereas motivational imagery (i.e., motivational general-arousal, motivational general-mastery, and motivational specific) enhance competition performance. Younger soccer players employ cognitive general and cognitive specific imagery techniques to a greater extent than older soccer players. Combined cognitive training strategies were more beneficial than a single cognitive strategy relative to motor skills enhancement in elite (particularly midfielders) and amateur (i.e., when practicing complex and specific soccer skills in precompetitive period) soccer players. In conclusion, it appears that there are differences in cognitive/psychological training interventions, and their efficacy, according to whether they are directed towards training or competition, and the age, standard and playing position of the players.

Key-words: cognitive training, imagery, self-talk, soccer, performance

Introduction

Soccer players are required to have well-developed physical and technical abilities, combined with a wide range of offensive and defensive skills (Stolen et al., 2005). Further, they should have a suitable psychological apparatus to cope with challenges, stress and pre-competitive anxiety. The physiological attributes of soccer players are complex, requiring highly developed speed, agility, muscular strength and power, and maximal aerobic capacity (Stolen et al., 2005), amongst others. Furthermore, psychological factors, such as self-efficacy, self-confidence, motivation, and mental toughness, have long been considered as essential ingredients for performance excellence and well-being in soccer (Coulter et al., 2010; Lowther et al., 2002; Morris, 2000; Thelwell, Weston, & Greenlees, 2005). As such, several researchers argue an inter-disciplinary training program relying on physical, technical, tactical, and cognitive preparation/development is vital to long-term player development and goal attainment in soccer (Munroe-Chandler et al., 2005; Sadeghi et al., 2010; Seif-Barghi et al., 2012; Thelwell, Weston, & Greenlees, 2005).

There has been research to suggest that appropriate cognitive training (often in the form of an additive intervention relative to 'normal' physical, technical and tactical training) may help optimize development relative to training and athletic performance outcomes in team sports (Evans, Jones, & Mullen, 2004; Munroe-Chandler et al., 2005; Sadeghi et al., 2010; Seif-Barghi et al., 2012). These positive effects have been ascribed to the attainment of mental states or mindsets facilitating individual performance to 'flow' automatically with minimal cognitive disruption (Kee and Wang, 2008). Mental states considered key to such 'flow' include optimal arousal, self-efficacy and focused attention. Further, these mental states are postulated to facilitate enhanced skill execution due to favorable changes in motor unit recruitment (Cumming & Williams, 2014). Thus, increased positive team interactions are purported to coincide with attainment of these mental states (Jackson, 1995).

Sport psychologists have proposed different cognitive training strategies or psychological skills training, such as self-talk, imagery, relaxation, goal setting, and biofeedback, as having efficacy relative to long-term player development and goal attainment in various sports (Barwood et al., 2015; McCormick, Meijen, & Marcora, 2015). For example, self-talk, defined as "…a dialogue in which an individual interprets feelings and perceptions, regulates and changes evaluations and convictions, and gives himself or herself instructions and

reinforcement" (p. 355; Hackfort & Schwenkmezger, 1993), can improve self-efficacy, motivation and soccer performance (Johnson et al., 2004). Imagery, defined as "using all the senses to recreate or create an experience in the mind" (Vealey & Walter, 1993), can also exert a beneficial effect on cognitive (Munroe-Chandler et al., 2005) and soccer performance (Papaioannou et al., 2004; Seif-Barghi et al., 2012). These approaches (self-talk and imagery) when combined (e.g., self-talk, imagery and relaxation) facilitate an enhanced effect specific to soccer, including facets of mental toughness, team cohesion, and technical skill execution (Brobst & Ward 2002; Gucciardi et al., 2009ab; Kerkez et al., 2012; Papanikolaou et al., 2012). Other combinations (goal setting and self-talk) were effective in enhancing a soccer-shooting task (Papaioannou et al., 2004), whilst relaxation, imagery, and self-talk in combination, increased specific soccer performance (Sadeghi et al., 2010; Thelwell et al., 2006).

Recent reviews (Hatzigeorgiadis et al., 2011; McCormick et al., 2015) have demonstrated that combined approaches, compared to discrete approaches, may have greater efficacy to enhance physical fitness. Combined cognitive strategies may also be beneficial for improving soccer midfielders' performances, when compared with other playing positions (i.e., defenders and forwards; Thelwell et al., 2006). No literature reviews, however, have systematically identified and evaluated research studies examining moderator variables influencing the cognitive training-soccer performance relationship. Determining the potential moderator variables (e.g., playing positions, intervention characteristics) should make it possible to develop more effective cognitive training interventions that might be particularly valuable for performance improvement in soccer players.

Cognitive training can enhance skill execution and sporting performance (e.g., Brown & Fletcher, 2016), facets of endurance (McCormick, Meijen, & Marcora, 2015), and strength and power (Tod et al., 2003; 2015). However, currently, and to the best of our knowledge, no systematic review has been devoted to the rigorous assessment of the effectiveness of cognitive training on soccer performance specifically, in terms of both motor and positive psychological skills development or the quality of the research underpinning knowledge. One advantage of systematic reviews is that they investigate whether the research has been designed and carried out adequately, with a precise rationale, and within a theoretically sound framework.

Previous reviews have failed to provide delineation of outcomes specific to soccer. Soccer imposes an individualized mix of cognitive, technical, tactical and social demands on performers, and as such a soccer orientated review may identify cognitive strategies most

pertinent for soccer players. These identified strategies could be optimized by sport psychologists and relevant members of the athlete support network, to ultimately be embedded into soccer-specific training and competition practice. Therefore, the present systematic review aims to extract pertinent literature concerning (a) the impact of cognitive training strategies on motor and positive psychological skills in soccer players and (b) the potential moderators of the "cognitive training-soccer performance" relationship.

Methods

Search strategy

This review was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) Statement guidelines (Moher et al., 2009) (Figure 1). A specific checklist and an *ad hoc* algorithm with the details of the screening questions were designed and pilot tested within a sample of articles before its implementation. One reviewer (MS) was contents expert, and one reviewer (NLB) was an experienced biostatistician/epidemiologist. Disagreement was resolved by consensus or involving a third reviewer (KC), when necessary.

Studies were obtained through both manual and electronic journal searches (from inception up to 31th May 2016). The present review used thirteen databases (listed in table 1) accessed via the "Uno per tutti" electronic platform available at University of Genoa. Electronic databases were searched using a string of keywords and/or medical subject headings (MeSH) terms and wild cards option, where appropriate, such as "soccer" or "football" in combination with the terms "cognitive training", "psychological skills training", "imagery", "self-talk", "goal setting", or "relaxation".

In addition, in order to broaden our search, the references section of the selected articles were searched by hand to identify other relevant articles. Also, target journals were hand-searched. For further details, the reader is referred to Table 1.

Figure 1 here

Table 1 here

Inclusion criteria

To be suitable for inclusion, studies had to fulfill the following Population/Intervention or Exposure/Comparison/Outcome(s) (PICO) criteria:

(a) P (population): soccer players at any experience level (amateur or competitive) and any age category;
(b) I (intervention/exposure): soccer players exposed to the following cognitive training strategies: imagery, self-talk, goal setting, relaxation, or psychological skills training package;
(c) C (comparison): studies to have included either a control group or condition against which an intervention could be compared;
(d) O (outcome): effect of cognitive training strategies on motor (e.g., dribbling, passing, shooting and checking off, specific soccer skills) and psychological (e.g., self-confidence, motivation, mood state, imagery ability) skills in soccer players.

Further, studies had to meet with following selection criteria:

(e) Study design: randomized controlled trials (RCTs) studies, qualitative study, single-subject, multiple-baseline-across-individuals design or investigations using a scientifically sound procedure such as staggered multiple-baseline across groups design (a study design particularly recommended in sports psychology);
(f) Original peer-reviewed articles;
(g) Language filter: original studies written in English.

Exclusion criteria

Studies not meeting with the above-mentioned PICO criteria were excluded, namely:

(a) Reviews, commentaries, interviews or expert opinions, letters to editor and editorials, posters, book chapters, and books, theses and dissertations, and conference proceedings. In general, non-peer reviewed or gray literature was discarded, in order to maintain only high-quality studies;
(b) Studies where the authors did not assess the effects of cognitive training specifically in soccer players or focused on outcome variables other than motor and psychological skills;
(c) Studies that examined the effects of psychological prevention interventions in soccer players (for example, studies in which interventions were designed to reduce injury rates);
(d) Studies not written in English.

Moderator variables

Overall, the current literature on cognitive training in soccer players provides ample evidence that all cognitive training strategies are an effective strategy for enhancing motor and positive psychological skills. Nevertheless, interesting questions have been raised concerning the factors that might govern cognitive training effectiveness. These factors can be classified into five broad categories: (a) sport situations (i.e., training, competition), (b) age of players, (c) participants' levels, (d) playing positions (i.e., defenders, forwards and midfielders), and (e) intervention characteristics.

Results

Search results

The initial search yielded 881 items, which, after removing the duplicates, reduced to 300. 277 studies were discarded and the full text of 23 studies was assessed for eligibility. Finally, only eighteen studies were included concerning the effects of cognitive training strategies on soccer players' performance (i.e., psychological and motor skills; Figure 1). Excluded studies with reason are shown in Table 2. The included studies focusing on motor and psychological skills are listed in Table 3 and Table 4, respectively.

Table 2 here

Demographic characteristics

Three studies (16.7%) chose amateur athletes as participants. Six studies (33.3%) selected student athletes, six studies (33.3%) used elite participants, two studies (11.1%) used elite, semi-professional and regional athletes as participants and one study (5.6%) did not describe the participants' level.

The number of recruited participants per study ranged between 3 and 102. However, there was an uneven distribution between male and female participants, with ten interventions involving males only, five interventions choosing females as participants, two studies involving both males and females. Three studies did not describe the participants' gender. The total population size included in this review was 584 (341 males: 58.4%, 216 females: 37%, and 27 subjects of unspecified gender: 4.6%). The subjects' age within the selected studies ranged from 7 to 39 years. The length of cognitive strategy-based training ranged from 4 weeks to 7 months. For further details, the reader is referred to Tables 3 and 4.

Table 3 here

Table 4 here

Types of selected studies

Of the 18 articles selected in the present review, 8 studies were RCTs (44.4%), 5 studies single-subject designs (27.8%), 3 studies multiple-baseline designs (16.6%), one study a qualitative study (5.6%), and one study with a pre-post design investigation (5.6%).

Types of interventions

From the eighteen studies that examined the effects of cognitive training strategies on soccer performance, eight studies (44.4%) used imagery, seven interventions (38.8%) used a combination of cognitive strategies. One study (5.6%) used self-talk, one study (5.6%) compared different cognitive training strategies (imagery vs. goal setting vs. self-talk vs. relaxation) and one study (5.6%) used relaxation as cognitive training strategy intervention.

Theoretical/conceptual framework

Assuming a well-established theoretical perspective is crucial for conducting a scientifically sound psychological investigation, both for designing an intervention and for properly interpreting data. However, of the eighteen articles, most studies (n=12, 66.7%) did not report having used any theoretical/conceptual framework in their investigation on the effects of cognitive training strategies on soccer performance.

Only six studies (33.3%) explicitly stated to have used a theoretical framework. In particular, two studies exploited the Paivio's conceptual framework. The Dual Coding Theory developed by Paivio in the seventies rejects the idea that the mind can be modeled as a computer and claims that nonverbal (mental) and verbal information, even though correlated, are different and are stored separately in long term memory (Paivio, 1971; Paivio, 1986). Imagery plays a major role in cognition, as well as it exerts motivational function.

Further, Pain and colleagues (2011) used also the the Personal Construct Theory (PCT) developed by George Kelly in the fifties and Csikszentmihalyi's conceptual framework. PCT emphasizes the role of anticipation and prediction in human life and the importance of preverbal (mental) concepts. Csikszentmihalyi describes optimal experience in terms of a flow made up of nine components (namely, 1. balance between challenge-skill; 2. action-awareness; 3. clarity of goals; 4. unambiguous feedback; 5. sense of control over actions and environment; 6. loss of self-consciousness; 7. concentration and focus on a specific task; 8. transformation of time, and 9. autotelic experience, that is to say curiosity, enjoyment, satisfaction and low level of self-centeredness).

One study used the Holmes and Collins' Physical, Environment, Task, Timing, Learning, Emotion, Perspective (PETTLEP) framework, which emphasizes motor and kinetic aspects (Holmes & Collins, 2001).

One study exploited the Lang's Bio-informational Theory. This theory, developed in 1979, links together physiology and behavioral/psychological sciences, suggesting that mental images can be conceived as products of the brain's information processing capacity and, as such, can be understood as conceptual networks controlling somatovisceral patterns and arousal (Lang, 1979).

One study used the Taylor's conceptual model, which claims that it is crucial to underpin a list of goals and that imagery has both motivational and cognitive effects (Taylor, 1995).

One study was guided by Locke and Latham's goal setting theory, elaborated in the sixties, which emphasized the importance of setting clear, achievable and realistic goals (Locke, 1968).

Types of outcome measures

From the selected studies, fourteen investigations examined motor skills (e.g., technical quality, successful pass rate, dribbling, passing, shooting and checking off, specific soccer skills) as performance outcomes after cognitive training (Table 3). Also, ten studies examined the effects of cognitive training on psychological skills (e.g., mood state, collective efficacy, flow state, perceived performance; Table 4). Five studies investigated the effects of cognitive training on both motor and psychological skills (Tables 3 and 4).

Effects of cognitive training strategies on soccer performance

Imagery

Tables 3 and 4 contain the outcomes of cognitive training strategies on soccer performance. In particular, mental imagery was found to improve motor skills (i.e., dribbling, passing, shooting and checking off, specific soccer skills) or soccer performance in terms of time, error performance, speed, and technical quality. Imagery was also found to have a positive effect on collective efficacy, self-confidence (particularly motivational general-mastery imagery in forwards and midfielders players), motivation and imagery ability (i.e., cognitive general imagery, cognitive specific imagery).

Relaxation/goal setting/Self-talk

Overall, relaxation was found to decrease the negative mood subscale scores (i.e., confusion, depression, fatigue, tension and anger scores), decrease stress and increase the players' energy levels. Furthermore, goal setting was found to increase motivation, attention, self-confidence, and focusing on championship. Finally, self-talk was found to increase soccer performance, motivation, and self-confidence in both amateur and elite soccer players.

Psychological training package or the combination of cognitive training strategies

The combination of cognitive training strategies was found to increase motor skills (i.e., shooting accuracy, ball control with the head, ball control with the feet, short passing, tackling, movement after receiving the ball, movement during restarts, and movement after passes), perceived performance, and sport and team cohesion.

Moderator variables of the cognitive training-soccer performance relationship

Overall, by reviewing the evidence, the current review shows that the sport situations (i.e., training, competition), age of players, participants' levels, playing positions (i.e., defenders, forwards and midfielders) and intervention characteristics may moderate the effectiveness of cognitive training on soccer performance.

When comparing imagery functions, the present review shows that participants' playing level, sport situations (i.e., training, competition) and age of players may moderate the effectiveness of imagery on soccer performance. Particularly, the combination of two different types of cognitive imagery training (i.e., cognitive general and cognitive specific) has a positive influence on soccer performance during training, whereas motivational imagery (i.e., motivational general-arousal, motivational general-mastery, and motivational specific) enhanced competition performance. Younger soccer players used cognitive general and cognitive specific imagery more frequently than older ones.

The combination of different cognitive training strategies (i.e., relaxation, self-talk, and imagery) for the development of soccer performance in elite midfielders players would be more beneficial than other playing positions (i.e., defenders, forwards), while non-elite soccer players generally report greater relaxation skill usage. Furthermore, amateur players would use the psychological training package/combination of cognitive training strategies in precompetitive period and when practicing complex and specific soccer skills.

Discussion

With regards to the primary purpose of the current review, our results revealed the effectiveness of cognitive training interventions on the development of motor and positive psychological skills in soccer players. More specifically, it seems that, whereas all cognitive training strategies improve motor (e.g., dribbling, passing, shooting and checking off, specific soccer skills) and psychological skills (e.g., self-confidence, motivation, mood state), some advantage may also be derived from the combination of cognitive training strategies. Furthermore, the current review showed that the sport situations, age of players, participants' levels, playing positions and intervention characteristics may moderate the effectiveness of cognitive training on soccer performance.

Imagery and/or relaxation

By reviewing the evidence, the current review shows that imagery enhances performance across a range of players in terms of gender, age, level etc. Particularly, imagery is a cognitive strategy that has achieved considerable interest among both researchers and sport practitioners in the last decade (Cumming & Williams, 2014). Several studies (Munroe-Chandler et al., 2005; Pain et al., 2011) suggested that imagery alone or in combination with other psychological skills (e.g., music, self-talk) can enhance the competition-related thoughts and emotions of players. The documented effects of imagery with respect to soccer and related sports include improved imagery ability (Munroe-Chandler et al., 2005), self-confidence (Sadeghi et al., 2010), motivation (Sadeghi et al., 2010), collective efficacy (Munroe-Chandler & Hall, 2005), successful technical skills (Seif-Barghi et al., 2012), perceptual training in soccer (Jordet, 2005), managed competitive anxiety (Hale & Whitehouse, 1998) and on rugby performance over the course of one competitive season (Evans, Jones, & Mullen, 2004). Moreover, the literature in sport psychology has suggested that players can use imagery to practice their technical skills, correct mistakes, practice performance strategies, prepare for competition, and facilitate injury rehabilitation (Heaney, 2006).

Among sport performers and coaches, imagery is a popular and well-accepted strategy for enhancing various aspects of soccer performance. The importance of this strategy is reflected by the type of skills assessed. The most interesting result was that the effectiveness of imagery could be practical in an open skill, team sport setting and in real world competitions. Strategies applied in all live scenarios of soccer are comprised of various specific skills; therefore it may be natural for players to use cognitive specific imagery in combination with cognitive general imagery in order to accomplish complex tasks (i.e., passing, dribbling and shot on goal) throughout a real-world game and specific soccer tasks (Munroe et al., 2000;

Veraksa & Gorovaya, 2012). Seif-Barghi et al. (2012) suggests that the combination of two types of cognitive imagery training has a positive influence on soccer performance during real competitions. Moreover, Munroe-Chandler et al. (2012) found that 7-8 year old soccer players receiving the cognitive specific imagery intervention increased their use of cognitive specific imagery and none of the athletes receiving the motivational general-arousal imagery intervention increased their use of motivational general-arousal imagery. They showed also that cognitive specific imagery intervention improved performance on the soccer task (i.e., decreased their time to complete the task) (Figure 2) and that cognitive specific imagery intervention had greater improvement of speed on the soccer task in younger age (7-10 years) than the older athletes (11-14 years). Interestingly, it has been shown that cognitive training such as imagery should be introduced to athletes who are more willing to embrace these skills and use them to their benefit.

*** Figure 2 here***

The present review showed that age of players and their competitive levels moderate the imagery use-effect relationship in soccer. In this view, Munroe and colleagues (Munroe et al., 2000; Munroe-Chandler et al., 2005) suggested that younger soccer players more frequently used cognitive general and cognitive specific imagery than the older counterparts. Thus, sport psychologists have suggested that young athletes have the capabilities to be great imagers (Munroe-Chandler et al., 2007), thereby perhaps engaging in more frequent use of imagery than adult players. Despite Blair et al. (1993) demonstrating that imagery can be equally effective for novice and skilled performers, in a soccer context novice players may be more likely to show measurable gains in acquisition of such skills (e.g., a soccer pass), unless tests are sufficiently sensitive to distinguish among elite performers. Elite players can already pass efficiently, and may not have much room for demonstrating further improvements in the performance of this skill (i.e., a ceiling effect). They may likely still benefit from using imagery for other reasons, however, such as to rehearse integrating passing with other soccer skills (e.g., pass and move to open space to get a return pass). Furthermore, to be successful, skilled performers must use appropriate strategies and tactics, while novice performers are just concerned with how properly to execute the basic movements comprising the task (Blair et al., 1993). In fact, soccer players, especially the elite players, reported using imagery (motivational function) usually prior to a game and, in general, more in conjunction with competition than

practice (Salmon et al., 1994). Consequently, it was evidenced that imagery use would increase with experience (Hall et al., 1998).

A previous study conducted by Munroe-Chandler et al. (2005) showed that the execution of soccer strategies (defending a direct free kick, taking a direct free kick, and defending a corner kick) was not significantly enhanced with the implementation of a cognitive general imagery intervention. In contrast, another study showed a small improvement of performance through an imagery intervention (Veraksa & Gorovaya, 2012). This contradiction could be due to the difference in sampling method, gender, outcome measure and the duration of imagery training. Thus, it is possible that the combination cognitive training strategies was more specific and compatible to outcome measurements of real soccer games (e.g., passing). Accordingly, some studies suggested that non-elite performers primarily use relaxation strategies (autogenic relaxation) and progressive muscle relaxation) to reduce anxiety intensity and the negative subscales score of mood state (confusion, depression, fatigue, and tension) (Hashim & Yusof, 2011; Neil et al., 2006). But, elite rugby players appear to maintain intensity levels and adopt a combination of skills to interpret symptoms as facilitative to performance (Neil et al., 2006).

Self-talk and/or goal setting

Self-talk can have positive effects on performance (Hatzigeorgiadis et al., 2011; Tod et al., 2011) and can be used to aid athletes in learning skills, correcting bad habits, preparing for performance, focusing attention, creating the best mood for performance, and building confidence (Sadeghi et al., 2010). Self-talk may also influence performance and technique during the vertical jump (Edwards et al., 2008). The current review has found that few studies have assessed the effectiveness of self-talk on soccer performance (Johnson et al., 2004; Papaioannou et al., 2004). Similarly, self-talk and goal setting have also been used successfully in multi-component packages in the improvement of soccer shooting task (Papaioannou et al., 2004). It has been suggested that the package approach or the combination of cognitive training strategies may enhance the probability of a treatment effect and encourage soccer players to incorporate a variety of cognitive strategies into their training routines. Soccer players believe that self-talk is an important aspect of their mental preparation (Sadeghi et al., 2010). Finally, based on the results in the current review, both goal setting and self-talk were effective in enhancing motor skill (i.e., soccer-shooting task), whereas some advantage may be derived from a combined intervention. More research in this area will help verify the accuracy of players' perceptions and the usefulness of the technique.

Psychological training package or the combination of cognitive training strategies

Some studies have focused on single psychological skill (or cognitive strategy) approaches (Munroe et al., 2000; Munroe-Chandler et al., 2008), while others have adopted multi-modal package approaches or the combination of cognitive training strategies (Lerner et al., 1996; Gucciardi et al., 2009a; Sadeghi et al., 2010; Thelwell et al., 2010). Particularly, imagery has been studied in isolation (Munroe et al., 2000; Munroe-Chandler et al., 2008) while in other studies imagery has been combined with or compared to other interventions, such as music (Pain et al., 2011), self-talk, relaxation and goal setting (Gucciardi et al., 2009a; Sadeghi et al., 2010; Thelwell et al., 2010).

Studies examining mental toughness training (MTT) or the combination of cognitive training strategies have reported more positive changes in football ratings of mental toughness, team cohesion, resilience, and flow and technical skills (Gucciardi et al., 2009ab; Kerkez et al., 2012; Papanikolaou et al., 2012). In addition, Papaioannou et al. (2004) showed that both goal setting and self-talk are effective in enhancing soccer-shooting task, whereas some advantage may be derived from a combined intervention. In this view, Brobst and Ward (2002) demonstrated that a psychological training package was effective in improving the practice performance of movement with the ball, movement during restarts, and movement after passes in female soccer players. Also, some studies have showed that the cognitive training strategy a player used was related to their playing positions. For instance, when defenders, forwards and midfielders are compared, it is evident that midfielders have a greater physical requirement because they link the defensive and forward units, acting in both a defensive and attacking manner (Thelwell et al., 2006). In addition to the physical demands, a soccer midfielder is required to carry out complex motor skills (e.g., tackling while in motion, receiving the ball and passing it on as an opponent approaches), perceptual skills (e.g., knowing when the ball will arrive, bringing the ball under control, timing a tackle) and decision-making skills (e.g., knowing the correct pass to make, knowing when to tackle). Moreover, such skills can become increasingly difficult as the length of activity is prolonged due to the effects of fatigue (Taylor, 1995). So far, the combination of multiple psychological skills (relaxation, self-talk and imagery) for the development of soccer midfielder performance would be beneficial (Thelwell et al., 2006).

Conclusion

The cognitive training strategies identified in the current review have evidence for their use during practice and competition in soccer. Specifically, they can have positive effects on soccer

performance, in terms of motor and positive psychological skills development. Cognitive training may also reduce game specific stress responses (i.e., decreased muscle tension and increased perceptual abilities) and increase self-confidence. However, combining cognitive training strategies (i.e. imagery, goal setting, self-talk and music) with physical training typically enhances positive experimental effects. Consequently, players could use cognitive training to practice their technical skills, correct mistakes, practice performance strategies, and prepare for competition and training.

Motivational imagery strategies (i.e., motivational general-arousal, motivational general-mastery, and motivational specific) have efficacy for positively influencing competition specific indices whilst the combination of two different types of cognitive imagery training (i.e., cognitive general or cognitive specific) are particularly effective for enhancing soccer performance during training. Age specific imagery use effects are seen, with younger soccer players employing greater cognitive general and cognitive specific imagery techniques compared to older soccer players.

Amateur players utilize the combination of cognitive training strategies/psychological training within precompetitive periods in addition to when practicing complex and specific soccer skills. Elite soccer players (in particular, midfielders) predominately use goal setting, imagery, and self-talk with non-elite counterparts demonstrating greater relaxation skill usage. For instance, the data obtained in the present review highlight that the sport situations (i.e., training, competition), age of players, participants' levels (i.e., elite or otherwise), playing positions (i.e., defenders, forwards and midfielders) and intervention characteristics may moderate the efficacy of cognitive training on the development/refinement of soccer-specific motor and positive psychological skills. Finally, the current review suggests performance and training benefits may result when coaches, athletes, and sport psychologists implement cognitive strategies in the football context. Future investigations examine the effects of cognitive training on physical fitness (e.g., repeated sprint ability (RSA), sprint, muscular power and strength performance) in soccer players are urgently needed to fill in the gap of knowledge.

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Tables.

Table 1. Search strategy of the present systematic review.

Search strategy item	**Details**
Used keywords	(“cognitive training” OR “psychological skills training” OR “imagery” OR “self-talk” OR “goal setting” OR “relaxation”) AND (football OR soccer)
Databases/*thesauri*	PubMed/MEDLINE (NLM), ProQuest Central, ProQuest Research Library, ProQuest Science Journals, ProQuest Nursing & Allied Health Source, ProQuest Health & Medical Complete, ProQuest Health Management, ProQuest Psychology Journals, ProQuest Social Science Journals, Informa - Taylor & Francis (CrossRef), Taylor & Francis Online – Journals, Directory of Open Access Journals (DOAJ), SpringerLink
Time filter	From inception until 31th May 2016
Language filter	English language
Target journals	British Journal of Sports Medicine; Cognitive Processing; International Journal of Sport and Exercise Psychology; Journal of Applied Behavior Analysis; Journal of Applied Sport Psychology; Journal Of Athletic Training; Journal of Imagery Research in Sport and Physical Activity; Journal of Sport & Exercise Psychology; Journal Of Sport & Exercise Psychology; Journal Of Sports Sciences; Journal of Strength and Conditioning Research; Knee Surgery, Sports Traumatology, Arthroscopy; Perceptual And Motor Skills; Physical Education and Sport Pedagogy; Plos One; Sport Psychologist; Sports Medicine

Table 2. List of excluded studies with reason for exclusion.

Excluded studies	Reason for exclusion
Abd Elaziz (2010)	Focusing on injury prevention but not on motor skills development
Edvardsson et al. (2012)	Focusing on injury prevention but not on motor skills development
Gucciardi et al. (2009a)	Choosing Australian footballers as participants
Gucciardi et al. (2009b)	Choosing Australian footballers as participants
Johnson et al. (2005)	Focusing on injury prevention but not on motor skills development

Table 3. Effects of cognitive training strategies on motor skills.

Study	Characteristics (age; gender; level; n; years of experience)	Study design; used statistical analyses	Cognitive strategy (length); used psychometric instrument; conceptual framework	Outcome	Impact of cognitive strategy on motor skills development
Blair et al. (1993)	20 yrs (range 18-28 yrs); female; elite and novice; 44 (22 and 22); minimum of 5 yrs (10.3 yrs) and <1 yr	Randomized study; descriptive statistics, factorial ANOVA	Imagery (6-week); no instruments; Paivio's theoretical framework	Motor skills (dribbling, passing, shooting and checking off)	- Facilitate the acquisition of serial motor skill; -↓ Time to complete the task ($p < 0.01$); -↑ Performance accuracy ($p < 0.025$)
Brobst and Ward (2002)	15-17 yrs; female; student; 3 out of 5 (1 injury, 1 drop-out); minimum 5 yrs	Multiple baseline design across behaviours study; descriptive statistics, inter-observer agreement, and social validity	PTP: public posting, goal setting, and oral feedback (season); no instruments; NR	Motor skills (movement after receiving the ball, movement during restarts, and movement after passes)	- ↑ Motor skills
Jenny and Munroe-Chandler (2008)	18.10±1.85 yrs; male (n=32) and female (n=65); student; 97 of 102 (5 drop-out, 1 male, 4 female); NR	Randomized study; descriptive statistics, ANOVA, rmANOVA	Three imagery strategies (real time; slow motion; slow motion concluded with real time); 8-item MIQ-R; the Holmes and Collins' PETTLEP framework	Soccer performance (dribbling task) in terms of time and error performance	-↑Soccer performance in terms of time performance for all groups ($p < 0.01$) -↑Soccer performance in terms of error performance for all experimental groups ($p < 0.01$), but not for control group
Johnson et al. (2004)	13 yrs; female; elite; 4; 6 yrs	Single-subject multiple-baseline-across-individuals design; descriptive statistics, inter-observer agreement, and social validation	Cognitive-specific, task-specific ST; no instruments; NR	Soccer performance (low-drive shooting)	-↑ Soccer performance (in 2 athletes)

Jordet (2005)	Soccer; 21- 24 yrs (22.0±1.7 yrs); male; midfield elite; 3; NR	Single case, multiple baseline across participants design	Ecological imagery (10-14 weeks) ; SIQ ; NR	Ball contact time interval, performance with the ball	-↑ Performance with the ball (in one athlete)
Kerkez et al. (2012)	10-12 yrs (11±0.7 yrs *versus* 11.2±0.6 yrs); male; healthy; 29 (14 *versus* 15) ; NR	Randomized matched pair-wise study; descriptive statistics, rmANOVA	PTP: imagery and AGR techniques (14 weeks ; 3 days a week, each session 10 minutes); NR	Motor skills (shooting accuracy, ball control with the head, ball control with the feet, short passing)	-↑ Motor skills
Munroe-Chandler et al. (2005)	12.54±0.66 yrs; female; elite; 13; 6.54±1.81 yrs	Staggered multiple baseline design across behaviors; descriptive statistics, rmANOVA, ICC	Imagery (7-week; 1 session per week); 12-item shortened version of SIQ, 4-item IAQ; Lang's Bio-informational Theory	3 soccer strategies (defending a direct free kick, taking a direct free kick, and defending a corner kick)	- Weak impact on soccer strategies execution (defending a corner kick)
Munroe-Chandler et al. (2012)	7-14 yrs (10.11±2.15); male (n=75) and female (n=68); amateur; 143 out of 163 (20 drop-out); NR	Randomized test; descriptive statistics, ANOVA, rmANOVA, Cronbach's alpha	Specific imagery (6 weeks) ; 21-item SIQ-C, 8-item MIQ-R ; NR	Soccer performance in terms of time and speed	-↓Time to complete the task -↑Speed on the soccer task (Figure 1)
Papaioannou et al. (2004)	15-39 yrs (mean=23 yrs); male; elite, semi-professional and regional division; 42; NR	Randomized study; descriptive statistics, rmANOVA, rmANCOVA	Three strategies (ST; goal setting; goal setting plus ST); no instruments; the Locke and Latham's theory	Soccer performance assessed with the Mor-Christian General Soccer Ability Skill Test Battery	-↑ Soccer-shooting task
Sadeghi et al. (2010)	25-36 yrs; NR; student; 8; 10 yrs	Qualitative study; content analysis	PTP (imagery, goal setting, ST, and relaxation); no instrument; NR	Soccer performance	-ST: ↑ performance

Seif-Barghi et al. (2012)	13-32 yrs; male; elite; 69 (35 *versus* 34) out of 88 (44 *versus* 44) ; NR	Randomized matched pair-wise study; descriptive statistics, GEEs	Imagery; no instrument; NR	Soccer performance (passing performance in terms of pass rate)	-↑Successful pass rate (OR=1.19, p= 0.002)
Thelwell et al. (2006)	19-23 yrs; male; student, mildfield players; 5; NR	Single-subject, multiple-baseline-across-individuals design; descriptive statistics, social validation	PTP: relaxation, imagery, and ST; no instrument; NR	Soccer performance (first touch, passing and tackling)	-↑Soccer performance
Thelwell et al. (2010)	20-23 yrs; NR; amateur midfield; 3; NR	Single-subject, multiple-baseline-across-individuals design; descriptive statistics, visual inspection; and social validation	PTP: relaxation, imagery, and ST (eight-game period); no instrument; Taylor's conceptual model	Soccer performance (successful pass, successful tackle and successful first touch)	-First and second half of games : ↑soccer performance
Veraksa and Gorovaya (2012)	8-14 yrs; male; student; 41; NR	Pre-post design; descriptive statistics, correlation analysis	Imagery (5 individual sessions during 12 weeks); SIQ, TTCT; NR	Motor skills (dribbling and shot on goal, assessed with TMS)	↑ Soccer's technical quality

Abbreviations. ↑: increased; ↓; decreased; AGR: autogenic relaxation; ANOVA: Analysis of Variance; GEEs: generalized estimating equations; IAQ: Imagery Assessment Questionnaire; ICC: Intra-Class Correlation; MIQ-R: Movement Imagery Questionnaire-Revised; OR: odds ratio; PTP: psychological training package; NR: not reported; rmANCOVA: repeated measures analysis of co-variance; rmANOVA: repeated measures ANOVA; SIQ: Sport Imagery Questionnaire; SIQ-C: SIQ for Children; ST: self-talk; TMS: test of movement skill; TTCT: Torrance Tests of Creative Thinking.

Table 4. Effects of cognitive training strategies on soccer performance in terms of psychological variables.

Study	Characteristics (age; gender; level; n; years of experience)	Study design; used statistical analyses	Cognitive strategy (length); used psychometric instrument; conceptual framework	Outcome	Impact of cognitive strategy on psychological skills development
Hashim and Yusof (2011)	13-15 yrs (mean=14.1±1.3); NR; 16; NR	Randomized matched pair-wise study with a pre-post design; descriptive statistics, factorial ANOVA	AGR, PMR (3 sessions per week for 4 weeks); 24-item POMS-A; NR	Mood state	Reductions in the negative subscales score of mood state for both groups: confusion (p=0.03), depression (p=0.03), fatigue (p=0.04), and tension (p=0.02) scores, while a pattern of decrease was found in the anger
Johnson et al. (2004)	13 yrs; female; elite; 4; 6 yrs	Single-subject multiple-baseline-across-individuals design; descriptive statistics, inter-observer agreement, and social validation	Cognitive-specific, task-specific ST; no instruments; NR	Psychological variables (level of confidence, appropriate attentional focus)	-↑ Psychological variables
Jordet (2005)	Soccer; 21- 24 yrs (22.0±1.7 yrs); male; midfield elite; 3; NR	Single case, multiple baseline across participants design	Ecological imagery (10-14 weeks) ; SIQ ; NR	Visual exploratory activity (frequency, and advanced exploratory	-↑Visual exploratory activity (two of the participants appeared to increase their exploratory activity frequency and exploration–ball contact time interval)

				activity percentages)	
Munroe-Chandler et al. (2005)	12.54±0.66 yrs; female; elite; 13; 6.54±1.81 yrs	Staggered multiple baseline design across behaviors; descriptive statistics, rmANOVA, ICC	Imagery (7-week; 1 session per week); 12-item shortened version of SIQ, 4-item IAQ; Lang's Bio-informational Theory	3 soccer strategies (defending a direct free kick, taking a direct free kick, and defending a corner kick)	-↑Imagery ability -↑ CG (p=0.00), CS (p=0.01) and MG-A (p=0.02) - No effect on MG-M and MS
Munroe-Chandler and Hall (2005)	10-12 yrs; female ; competitive traveling soccer club (forwards/strikers n=3, midfielders n=4, defense/goal keepers, n=8).; 15; 6.2±0.86 yrs	Staggered multiple-baseline across groups design; descriptive statistics, visual inspection, binomial test	Motivational general-mastery imagery 13-week (entire season); 10-item Confidence Questionnaire, IAQ; NR	Collective efficacy and confidence	-↑Collective efficacy scores for both training and competition of forwards (p <0.001) and midfielders (p <0.05) - No change in collective efficacy scores for defense/goal keeper
Munroe-Chandler et al. (2012)	7-14 yrs (10.11±2.15); male (n=75) and female (n=68); amateur; 143 out of 163 (20 drop-out); NR	Randomized test; descriptive statistics, ANOVA, rmANOVA, Cronbach's alpha	Specific imagery (6 weeks) ; 21-item SIQ-C, 8-item MIQ-R ; NR	Soccer performance in terms of time and speed	-↑CS imagery (for 7-8 yrs group, p <0.01) -No impact on MG-A
Pain et al. (2011)	20.9±1.6 yrs; male; student; 5; NR	Single-subject multiple-baseline across individuals design; descriptive statistics, content analysis	Imagery + music (precompetitive); 36-item FSS, BMRI-2, 18-item MIQ; the Personal Construct Theory and Csikszentmihalyi's conceptual framework, Paivio's theoretical framework	Perceived performance	-↑Flow state -↑Perceived performance
Papanikolaou et al. (2012)	18 -34 yrs (mean=24.6 yrs); male; first division (students and non-students); 30; NR	Randomized study; descriptive statistics, rmANOVA	PSTP (7-month); 7-item SCQ, TCQ ; NR	Sport and team cohesiveness	-↑Sport (p <0.05) and team (p <0.05) cohesion for the first team players, whilst a decreases was found for the reserve group

Sadeghi et al. (2010)	25-36 yrs; NR; student; 8; 10 yrs	Qualitative study; content analysis	PTP (imagery, goal setting, ST, and relaxation); no instrument; NR	Soccer performance Psychological variables (self-confidence, motivation, attention, focus, stress, energy)	-Imagery: ↑self-confidence and motivation -Goal setting: ↑ motivation, attention, self-confidence, and focusing on championship -ST: ↑ performance, motivation, and self-confidence -Relaxation: ↓ stress, ↑ energy

Abbreviations. ↑: increased; ↓; decreased; AGR: autogenic relaxation; ANOVA: Analysis of Variance; BMRI-2: Brunel Music Rating Inventory 2; CG: cognitive general imagery; CS: cognitive specific imagery; FSS: flow state scale; IAQ: Imagery Assessment Questionnaire; ICC: Intra-Class Correlation; MG-A: motivational general-arousal imagery; MG-M: motivational general-mastery imagery; MIQ-R: Movement Imagery Questionnaire-Revised; MS: motivational specific imagery; PTP: psychological training package; NR: not reported; PMR: progressive muscle relaxation; POMS-A: Profile of Mood States-Adolescents; PSTP: psychological skills training program; rmANOVA: repeated measures ANOVA; SCQ: Sport Cohesiveness Questionnaire; SIQ: Sport Imagery Questionnaire; SIQ-C: SIQ for Children; ST: self-talk; TCQ: team cohesiveness questionnaire.