# Defining, assessing, and developing creativity in sport: a systematic narrative review

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# Defining, assessing, and developing creativity in sport: a systematic narrative review

Research on creativity in sport is gaining momentum, due to a growing interest from coaches and academics in developing strategies to increase unpredictability in individual and collective behaviour which may allow teams to gain an important advantage over their opponents. The purpose of this paper was to conduct the first systematic narrative review of the literature on sporting creativity, critically synthesising 51 years of published research (1967-2018) and proposing avenues for future research. Six databases were used, and 48 documents met search criteria. The findings are organised in four categories: (a) defining creativity, (b) correlates of creativity, (c) assessing creativity and (d) developing creativity. Creativity definitions and assessments have privileged thought processes over the ability to act. A distinction is warranted between creativity about sport and creativity in sport (in action) and aligned assessment methods. The literature does not support a single strategy for the development of sporting creativity but does support its trainability. Evidence of the effectiveness of programmes for the enhancement of sporting creativity is growing but is still limited. Furthermore, while it is recognised that coaches have a pivotal role in the development of sporting creativity, research involving them is still scarce.

Keywords: creativity; sport; complexity; deliberate practice; deliberate play

## Introduction

Creativity is a topic that attracts attention from all areas of society and domains of performance (Runco, 2014). Dietrich and Haider (2017, p.1) describe it as the "fountainhead of our civilizations and a defining characteristic of what makes us human". Since J.P. Guilford's historical speech as part of the American Psychological Association's (APA) Presidential Address in 1950, research on creativity has risen dramatically, even though not to a level that can reflect "its importance both to the field of psychology and to the world" (Sternberg & Lubart, 1999, p.12). Over the past seven decades, many different lines of research have been explored – e.g. divergent thinking,

intelligence, giftedness – and many frameworks, mostly derived from cognitive psychology, have tried to explain the mechanisms of the creative process – e.g. blind-variation and selective retention (Campbell, 1960), associative theories (Mednick, 1962), *geneplore* (Finke, Ward, & Smith, 1992), stage models (Wallas, 1926), componential models (Amabile, 1990), investment models (Sternberg & Lubart, 1991), and contextual models (Gardner, 1993; Csikszentmihalyi, 1996).

In sport, creativity has also seen increased interest from researchers and practitioners (Memmert, 2010), with an exponential growth occurring in the last two decades. The advent of performance analysis and the widespread availability of information on teams and players' behaviours mean that creativity in sport has never been more necessary. It is therefore unsurprising that many stakeholders are trying to develop alternative approaches that increase unpredictability in individual and collective behaviour to be more 'successful' (Yamamoto & Yokohama, 2011 in Torrents et al., 2016).

While important advancements have been made, much remains to be understood about this complex phenomenon. Therefore, the purpose of this review was to critically explore conceptualisations of sporting creativity and methods recommended for its assessment and development, while also suggesting avenues for future research.

## Method

Given the emerging nature of the field and the absence of previous reviews on sporting creativity, it was deemed appropriate to conduct a literature review (Grant & Booth, 2009)that focused on a comprehensive search of the existing literature, without assessing the quality of evidence available. Six databases were used: PUBMED, SportDiscus, Web of Science, ERIC, Scopus, and PsycINFO. Search terms were drawn from the seminal literature on creativity and based on Runco's (2014) definition of

creativity and its correlates (e.g. intelligence, innovativeness, imagination, inventiveness, originality). With regards to sport, the search used not only the overarching term – sport – but was complemented by Launder and Piltz's (2013) definition of team invasion games, court invasion games and court-divided games. Limited time and human resources led to a focus on these three game categories, where creativity is of "crucial importance" (Memmert, 2017, p. 479) when compared to individual sports, which tend to fall on the lower end of the complexity continuum (Brown & Gaynor, 1967; Memmert, 2011; 2017). The keyword search was the following: (creativ* OR imaginat* OR intelligen* OR inventive* OR innovative* OR original*) AND (sport* OR football OR soccer OR handball OR volleyball OR ultimate OR hockey OR lacrosse OR tennis OR rugby OR netball OR basketball OR badminton OR futsal OR korfball). Searches were adapted to the syntax of each database. No participant age limits nor English language limits were applied to searches.

After the initial searches, all titles considered relevant (n=196) were screened to determine their eligibility. One hundred were excluded. The next phase - abstract review – involved screening summaries and comparing them to the inclusion criteria. Eligibility was assessed by using the criteria presented in Table 1. The search did not retrieve any non-English results that would meet all inclusion criteria.

[insert table 1 here]

A full-text review of those documents retained (n=96) was conducted, resulting in the exclusion of 65. Additionally, a manual search process was conducted by using both forward and backwards snowballing approaches (Greenhalgh & Peacock, 2005), with two titles (n=2) being included. Finally, the most published authors in the field of creativity in sport (identified via Research Gate and Google Scholar) were contacted to

request further information on ongoing research that had passed the stage of data collection and on other work that could potentially enrich this review. This resulted in the integration of six more titles (n=6). After the initial search on April 2017, a final search was re-run on August 2018 and seven (n=7) more titles were added to the list. A total of 46 articles (see full description in Table 2) met eligibility criteria (see Figure 1 for a summary of the selection process). Two documents - an academic book and a book chapter - which did not meet the eligibility criteria (peer-review) were added by recommendation of a scholar who considered them key texts, authored by the most prominent researcher in the field . In total, 48 titles were included.

[insert fig.1 near here]

To identify potential patterns in the existing literature, organise them coherently, and reflect on their meaning and implications for research, a narrative structure was adopted and thematic analysis was used (Braun, Clarke, & Weate, 2017). An inductive approach was followed in the coding phase, with the content steering the evolution of the analytical process, which followed Braun, Clarke and Weate's (2017) proposed six-step process, although not always sequentially.

Higher-order themes (defining creativity, correlates of creativity, assessment of creativity, developing creativity) worked as central organising concepts around which lower-order themes revolve. As part of the active nature of the analytical process, disagreements between authors were resolved through constructive debate that included the opinions of critical friends - a departmental colleague with a background in sport psychology and football, and one of the leading authors contacted during the data collection process - (Berends & Johnston, 2005), until a final structure was agreed.

[insert fig.2 near here]

## Results

### *Defining creativity*

This higher order theme presents the review of how creativity is defined. It is comprised of four lower order themes: cognitive traditions, tactical creativity; creativity in sport *vs* creativity about sport; creativity in sport is emergent.

#### *Cognitive traditions*

Initial research on sporting creativity was based on the previous work of cognitive psychologists. Runco (2014) argues that the prevalence of cognitive theories of creativity can be explained by "an intuitive connection between cognition and creativity and because cognitive research is often very scientific" (p.1). To date, many different lines of research have been explored – intelligence, giftedness, divergent thinking (the ability to generate different possible solutions to a problem), and so forth. These research streams have also inspired work on sporting creativity (e.g. Memmert, 2006: Memmert & Roth, 2007; Igorov et al., 2015; Hopsicker, 2011).

A plethora of definitions of creativity has been proposed. Sternberg and Lubart (1999) suggested that for an action to be creative it must be novel and useful. Boden (2004) and Simonton (2012) added a third criterion: surprise. With regards to the assessment of the creativity of an individual, (Guilford, 1967) introduced three foundational dimensions: fluency (the ability to generate several responses), flexibility (the ability to generate different categories of responses) and originality (the ability to generate unusual responses). Memmert, the most cited author in the field, who participated in 44% of publications included in this review, frequently uses Guilford's (1967) dimensions to assess creative solutions in sport.

*Tactical Creativity*

Memmert adapted Sternberg and Lubart's investment model (1991) to coin a definition of *tactical creativity,* which refers to "those varying, rare, flexible decisions that play an important role in team ball sports like football, basketball, field hockey and handball" (Memmert, 2011, p. 94). Tactical creativity (or divergent tactical thinking) differs from game intelligence or convergent tactical thinking, that relate exclusively to the selection of the most effective solutions for a given problem (Memmert, 2010). Rather, tactical creativity emphasises the ability of players to generate the highest possible number of different motor solutions for a problem. Furthermore, it is proposed that tactical creativity can only occur in the offensive phase of a game, and not in defence (Memmert, Baker and Bertsch, 2010; Kempe and Memmert, 2018). The focus on attacking players and play has influenced the research conducted. For example, as part of participant selection, Memmert et al. (2010) asked coaches to identify the most creative attackers and least creative defenders. In another study, Kempe and Memmert (2018) focused on the creativity of the last eight actions leading to a goal scored in open play in football World Cups and European Championship. Based on their findings they concluded that creativity is particularly important for attackers and that creativity is "a decisive factor for success in soccer" (2018, p.4).

In contrast, professional football coach Jose Tavares, interviewed by Tamarit (2016) contends that all players can be creative, in any phase of the game, with and without the ball. That creativeness should be shaped and evaluated against the specific requirements of each player's position. For example, defenders can produce creative actions within the specificity of their role, while a winger can do the same, perhaps through different strategies, more adapted to the position's requirements and dependent on the team's overarching game model – a way of playing. The interdependence

between attackers and defenders is supported by the work of Aggerholm, Jespersen and Ronglan (2011), who performed a contextual analysis of the feint in association football. They concluded that other than self-awareness and the cultivation of embodied habits, to be creative "it is also necessary to be absorbed in the other and transcend his or her expectations" (2011, p. 343). Consequently, the emergence of tactical creativity may depend not only on individual or cooperative efforts but also from this relationship with the opposition – the *duel.*

*Creativity in sport vs Creativity about sport*

An aspect of creativity conceptualisation that lacks consensus is the role of performance. Some suggest creativity depends on the final product, creative performance (e.g. Kaufman & Sternberg, 2007), others emphasise the ability to generate ideas, even if these are not materially expressed (see Runco, 2014 for a comprehensive insight on this discussion). Brown and Gaynor (1967) proposed that sporting creativity needs to be expressed through non-verbal motor skills (creativity *in* action as opposed to creativity *about action*). These creative motor skills can be expressed individually or collectively, and the level of creative potential of an action depends on its complexity. For example, running 100 meters in a straight line has less creative potential (i.e. less different possibilities for action) than playing a game of basketball.

Brown and Gaynor (1967) also argued that the creative processes in sport operate much in the same way – preconscious incubation preceding the emergence of the creative action - as those of other areas which do not require physical exertion (e.g. writing, composing). Recent neuroscientific findings on the impact of mechanisms of brain inhibition on creative performance suggest this may not be the case. In their reticular-activating hypofrontality (RAH) model of acute exercise, Dietrich and

Audiffren (2011) argue that the brain uses two different cognitive systems to acquire and represent information: implicit and explicit. The explicit system deals with abstraction and complex problem-solving, being linked to more traditional forms of creative expression – e.g. writing, composing. It is rule-based, relates to conscious awareness, and can be expressed verbally.

On the other hand, the implicit system, to which motor skills are related, relies heavily on procedural knowledge, which cannot be verbalised, depending therefore on task performance to be expressed. Therefore, sporting creativity, in part, may operate differently to creativity in some other domains because the expression of creativity is through action rather than about action. Furthermore, the unstructured nature of many sports, particularly team sports, demands constant reaction and adaptation to different stimuli. Real-time creativity is limited by time constraints and is necessarily spontaneous (Harrison, 2016). This has implications for the conceptualisation and assessment of sporting creativity as well as the design of interventions to facilitate creativity in sport.

*Sporting creativity as an emergence*

The idea of body-mind integration (Brown & Gaynor, 1967; Hristovski et al. 2011; Hristovski et al., 2012; Campos, 2014; Krein & Ilundáin-Agurruza, 2017; Ilundáin-Agurruza, 2017), as opposed to the traditional privileging of the mind, has important implications for the conceptualisation and development of sporting creativity. Challenging established ideas of the brain as the trigger of all action, Gibson (1979) argued that information, i.e. spatiotemporally patterned energy flow from the environment, is the key element to locomotion and manipulation and that the interaction between the individual and the environment was critical. In this perception-action system, meaning comes from the individual's ability to detect information in the

environment (Araújo, Hristovski, Seifert, Carvalho, & Davids, 2017). Furthermore, physical exploration of the landscape of action possibilities may result in the discovery or emergence of a novel action.

Orth, van der Kamp, Memmert, and Savelsbergh (2017) also emphasise the importance of adaptability to the environment in motor creativity, which they define as "new ways of acting adaptive or acting adaptively in new situations" (p.2). As such "the emergence of highly novel movement forms requires a self-organising system which, under suitable boundary conditions, can create new behavioural structures" (Hristovski et al., 2011, p. 177). These constraints offer the individual opportunities for action, which Gibson (1979) termed *affordances.* For example, Tanggaard, Laursen, & Szulevicz (2016) showed that changes in equipment (material constraints), in this case, the material that handballs were made from (synthetic polyurethane compared with leather), led to new possibilities for creative expression.

### *Correlates of sporting creativity*

Following the tradition of cognitive psychology, earlier investigations of sporting creativity attempted to identify isolated variables that contribute to increased creativity. Researchers have examined a relatively limited range of variables, which are discussed under three lower-order themes: giftedness, attention and pattern recognition, and other traits and skills.

#### Giftedness

The research examining giftedness and creativity has demonstrated that gifted children (IQ>130) tend to express creative behaviour earlier than their non-gifted peers. For example, Memmert (2006) investigated the creative performance of children who, once a week and for six months, underwent a sports enrichment programme which

consisted mainly of diversified team ball sports practice (using feet, hands, and a hockey stick) in game forms. Memmert found that while there was no significant improvement in the gifted control group, the gifted experimental group showed a significant increase in creative performance after six months. The non-gifted experimental group did not show a significant improvement as a result of the intervention. However, in a different study with non-gifted children, Memmert and Roth (2007) showed a 40% improvement in creative performance after a 15-month training period. Memmert (2006) explained the accelerated improvement of the gifted group in the shorter programme was a result of "faster automation of individual thought processes… This frees attention capacity for other tasks" (p.108). Therefore, creativity is not a characteristic of only gifted children, it can be developed by others but may take longer.

Attention and pattern-recognition

Brown and Gaynor (1967) highlighted the crucial role of extreme awareness in creativity by suggesting that "the athlete who is most creative is most aware, most in tune with reality as it exists. Being aware of the single large problem (the game), he [sic] is able to recognise and to act on smaller problems which arise continually" (1967, p.157). It is, therefore, perhaps, unsurprising that breadth of attention as a correlate of creativity has received the most research attention (e.g. Memmert, 2006b; Memmert & Furley, 2007; Furley, Memmert & Heller, 2010; Moraru et al., 2016). This work has focused particularly on inattentional blindness, which relates to the diversion of attention where people fail to notice something unexpected, even when it is in their field of view (Memmert, 2006).

In a series of experiments, Memmert and Furley (2007) examined inattentional blindness in youth handball players, using a video task. They were interested in

participants' ability to notice an unmarked player that appeared unexpectedly in the game and the effect of different instructions and actions of the unmarked player. They found that when there were no other conditions, 45% of participants failed to notice the unmarked player, however, when one group was given closed-end instructions 83% of participants failed to notice the unmarked player. This contrasted with only 17% of those participants who were not given these instructions failed to notice the player. Furthermore, when the unmarked player waved his arms only 6% of participants failed to notice him. Connecting inattentional blindness with creative performance, Memmert (2011) examined the relationship between attention and experience in both general and sporting creative performances. The study involved skilled (with a previous degree of experience in team invasion sports) and non-skilled (with no previous experience) handball players aged between 7 and 13 years. He found that inattentional blindness was higher in the youngest children (7 years of age) and performance of attention tasks improved in children between the ages of 8 and 13 years. Memmert also noted an evident plateau in the children between 10 and 13 years, which was attributed to the decrease in the "absolute number and density of synapses as one grows older, making it harder to improve creative thinking" (Memmert, 2011, p.93).

Adding further evidence of the relationship between attention and creative performance, Moraru, Memmert, and van der Kamp (2016) manipulated participants' breadth of attention. Participants in the broad focus group were more inclined to use more different modes of locomotion (flexibility), but not invest as much time on finding solutions within a particular mode (persistence). A broader focus did not significantly enhance originality, which is in contrast to results of previous studies on divergent thinking (e.g., Memmert, 2011). This can be explained by the increased difficulty of performing a wider range of motor skills (which is largely limited by existing motor

ability) in comparison to thinking (ideation) skills: "if motor ability is insufficient (e.g. only a few people can walk on hands), then the thought of action cannot be performed" (p.10).

Furthermore, Memmert (2006b) demonstrated that a six-month attention-broadening training program had a positive effect on the creative performance of children. He compared an attention-narrowing group (with teachers giving explicit tactical instructions and corrections constantly during play) with an attention-broadening group (with teachers only giving general advice about the games and their rules, and not providing any kind of feedback during play). Memmert found that only the attention-broadening group considerably improved their general creative performance.

An association between creative performance and visual search behaviours has also been demonstrated by Roca, Ford, and Memmert (2018) who used a portable eye-movement registration system to examine creativity in decision-making and visual search behaviours of expert football players during simulated 11-a-side matches. They found that more creative players, when compared to their less creative counterparts, displayed a broader attentional focus which included a higher number of fixations, but of shorter duration. They were also able to perceive earlier the location of unmarked teammates and opponents.

## Other traits and skills

The relationships between creativity and a small number of other traits and skills have been examined. These include: working memory, morning-eveningness personality, coping, and regulatory focus. Researchers have examined the role of working memory in sporting creativity – both creative thinking and creative action, however, no evidence has been found that working memory interferes with creative

ability (Furley & Memmert, 2015; Moraru, Memmert, & van der Kamp, 2016). With regards to morningness-eveningness personality, Cavallera, Boari, Labbrozzi and Del Bello (2011) found that participants with an intermediate (not morningness nor eveningness-oriented) personality type had significant positive correlations between the number of hours of sport activity per week and scores of elaboration (measured through the Torrance Test of Creative Thinking - TTCT). Creative thinking performance, however, was independent of gender and personality typology. In their study of junior female handball players, Igorov, Predoiu, Predoiu and Igorov, (2016) found a significant positive correlation between fluency and positive reinterpretation as a coping strategy but the relationship between coping and flexibility was not significant. They speculated that these findings relate to situations in which athletes try to find positive aspects in undesirable situations, often through the recollection of past successful performances. In relation to regulatory focus, Memmert, Hüttermann, and Orliczek (2013) found that adult male football players with a promotion (aspirational) focus performed better in a sport-specific divergent thinking video task than those with a prevention (duty-oriented) focus, which corroborates repeated claims (e.g. Hopsicker, 2011; Ďuriček, 1992) that risk-taking and open-mindedness enable creative behaviour and an avoidance focus may constrain creative behaviour. Hüttermann, Nerb, and Memmert (2018) have recently replicated the earlier study by Memmert, Hüttermann & Orliczek (2013), to investigate the relationship between regulatory focus, expectations and performance, among a more experienced sample. While promotion focused players displayed, once again, significantly higher values in terms of creativity, there was no main effect on expectation nor any significant interaction.

***Assessing Creativity***

This higher order theme captures the methods employed to assess creativity in sporting environments. The theme comprised three lower order themes: paper-and-pencil tests, computerised and video tasks, and performance-based situations.

*Paper-and-pencil tests*

Several different pencil and paper tests have been used to assess sporting creativity, either in part or in full. These tests are largely adapted from psychological tests and assess general creative thinking. One of the most commonly employed measures of creative behaviour is the TTCT). It exists in two formats – figural and verbal – and assesses creative thinking through four components fluency, flexibility, and originality, plus elaboration (amount of detail in responses) (Cavallera, Boari, Labbrozzi, & Bello, 2011; Veraksa & Gorovaya, 2011; Bowers, Green, Hemme, & Chalip, 2014;Santos et al., 2017). The main advantage of the TTCT is that it is one of the few valid and reliable tests of divergent thinking (Kim, 2011). Others tests that have been employed include Roco's (2004) Imagination and Creativity Test (e.g., Igorov, Predoiu, Predoiu, & Igorov, 2016). and Krampen's (1996) Divergent Thinking Test (Memmert, 2007). However, the very small sample (n=11) and lack of detailed information on Roco's (2004) test suggest limited validity and reliability of Igorov et al.'s (2016) results. Moreover, all tests enumerated are tests of generalist *thinking* expressed verbally or through drawing, not a measurement of physical *doing*.

*Video and monitor tasks*

Memmert and colleagues (Memmert, 2011; Memmert, Hüttermann, & Orliczek, 2013; Furley and Memmert, 2015; Roca, Ford & Memmert, 2018; Hüttermann, Nerb, & Memmert, 2018) are the only researchers, to date, who have used video and monitor tasks to examine the relationship between sporting creativity and other cognitive skills

or traits – e.g. attention, working memory, visual search behaviour, regulatory focus. The tasks involve participants watching videos of sporting gameplay and then being asked to provide possible attacking options. For example, in a handball-specific task (Memmert, 2011), participants watched five videos of a handball game involving four attackers and four defenders. After one minute, the video would stop, and the last frame would remain on the screen. Participants would then be asked to imagine they were an attacker and indicated all potential opportunities that could lead to a goal. The proposed options are assessed for creativity using traditional criteria of originality, flexibility and fluency. A football-specific video task has also been developed. It is composed of 20 different football attacking scenes from 46 Bundesliga 1 and 2 matches (Germany, season 2010/2011), selected by experienced certified coaches (Memmert, Hüttermann, & Orliczek, 2013; Furley & Memmert, 2015; Hüttermann, Nerb, & Memmert, 2018).

Video tasks are more representative of sport when compared to paper-and-pencil tests. Memmert (2015) suggests that although standardised video tasks are less complex, they have less confounding variables and the selection of clips shown to participants can be adjusted to reflect specific situations. Roca, Ford and Memmert (2018) acknowledged the limited physical realism of these tasks, which "might alter the natural role of the underlying perceptual-cognitive processes underpinning players' creative behaviour" (p.2), proposing instead the adaptation of Furley and Memmert's (2015) task to life-size-video based simulations in which participants had to play an actual ball in addition to providing a verbal response.

However, despite in different degrees, video tasks still focus on divergent thinking as the only measure of creative ability. Convergent thinking, i.e. the orientation "toward deriving the single best (or correct) answer to a clearly defined question" (Cropley, 2006, p. 391) also contributes to creative insights (Dietrich & Haider, 2017) but is not

399 considered. Furthermore, like paper-and-pencil tests, most of these tasks do not allow
400 for a realistic assessment of sporting creativity *in action.*
401
402 *Performance-based situations*
403 Performance-based situation tests, where participants' actual performance is assessed
404 for creativity, have been developed and employed by researchers (e.g., Memmert, 2007;
405 Torrents et al., 2016). Moraru, Memmert and van der Kamp (2016), used an agility
406 ladder in a divergent doing task. Participants were asked to perform the highest possible
407 number of different actions on the agility ladder, i.e. using their feet and hands for
408 stepping, hopping, skipping, walking, and so forth. While this approach is arguably
409 more representative of creativity in action compared with paper and pencil tests and
410 video tasks when considering its use, researchers perhaps should ask how well it
411 represents creativity in specific sporting contexts.
412 The use of small-sided formats is an alternative that has enhanced
413 representativeness in comparison to the agility ladder, as it tests players in actual game
414 forms. Criteria of originality, flexibility, and fluency are used to assess performance,
415 with scores being averaged into a single measure of creativity. For example, Memmert
416 and Roth (2003) created *game-test situations (GTS)* where creative performance is
417 assessed through *orienting and supporting* and *identifying gaps* actions of participants
418 during small-sided games (for a detailed description see Memmert, 2006). In Memmert
419 and Roth (2007), children performed with hands, feet and a hockey stick, but in other
420 studies, only one of the skills was evaluated (e.g. Memmert, 2010).
421 Along similar lines, Torrents and colleagues (2016) examined differences in
422 exploratory behaviour motivated by numerical superiority, equality, or inferiority with
423 44 football players (22 professional and 22 amateur players) using small-sided games (4

vs 3, 4 vs 5, and 4 vs 7). An observation instrument (adapted from Owen et al., 2014, and Costa et al., 2011) was used to record the possible actions from attackers with the ball (e.g. run to the ball, control, pass, shoot) or without the ball (e.g. wall, support, unmark) and from defenders (e.g. press, delay, dissuade). Santos and colleagues (Santos et al., 2017; Santos et al., 2018) also used small-sided games and an observation instrument (Creativity Behavior Assessment in Team Sports - CBATS) to assess in-game individual (passing, dribbling and shooting actions) and collective behaviour (regularity of team movements and distance between players which was assessed through GPS measurements). A creative behaviour score was established and included attempts – defined as the effort to perform different actions, successful or unsuccessfully -, fluency – the ability to execute the highest possible number of successful movement actions, and versatility – the ability to generate a diversity of actions within the same category, e.g. different types of passing or shooting.

The design and use of game-based situations and accompanying observation tools to assess sporting creative behaviour is an important development with regards to task representativeness and ecological validity, particularly when it includes assessment of individual as well as collective behaviours (e.g., Santos et al., 2017; 2018). Only Torrents and colleagues (2016) included creative defensive behaviour, although they did not include goalkeepers, which again limits our understanding of sporting creativity in all phases of the game. Furthermore, Santos and colleagues (2017; 2018) and Memmert and Roth (2007) measured creativity in situations of numerical equality, or superiority, however, Torrents and colleagues (2016) found that numerical inferiority might lead to greater exploratory behaviour.

Memmert (2015; 2017) has proposed the use of game observation of real matches as a new standard to evaluate tactical performance due to its “very high

ecological validity" (p.482). These observations can be aided by game play protocols which combine quantitative (e.g. frequency of certain behaviours) and qualitative components (the subjective yet knowledgeable opinions of experts). Finally, Memmert (2017) suggests that technology can play an important role in analysing creative behaviour. For example, using neural networks to categorise action processes in team sports (e.g. Memmert & Perl, 2009).

### *Developing Creativity*

Understanding how to develop creative players is one of the key ambitions of academics and practitioners. It is then unsurprising that a growing body of literature on the topic is emerging. Four lower-order themes were developed through the review: deliberate practice and deliberate play; social priming; programmes for the development of sporting creativity; the central role of coaches in creative development.

#### *Deliberate Practice, Deliberate Play*

In line with research conducted on expertise, skill acquisition and talent development (Davids, Güllich, Shuttleworth, & Araújo, 2017), six studies on sporting creativity (Memmert, 2006; Memmert, Baker, & Bertsch, 2010; Greco, Memmert, & Morales, 2010; Bowers, Green, Hemme, & Chalip, 2014; Martin & Cox, 2016; Hendry, Williams, & Hodges, 2018) have devoted attention to deliberate practice and deliberate play. Deliberate practice is "the engagement in practice activities with a clear goal of improving a specific aspect of performance beyond its current level". (Ericsson, 2017, p. 4). In turn, deliberate play, which is usually fostered during sampling years (ages 6-13), does not intentionally focus on performance improvement, prioritising instead "developmental physical activities that are intrinsically motivating, provide immediate gratification, and are specifically designed to maximize enjoyment" (Berry, Abernethy, & Côté, 2008, p. 687).

After a six-month intervention, Memmert (2006) found that deliberate play had a positive impact on the tactical creative performance of gifted children. Similarly, in a field study involving Brazilian youth basketball players, Greco, Memmert, and Morales (2010) discovered that unstructured play significantly improved measures of tactical creativity and tactical intelligence (i.e. finding the most appropriate solution for a problem). In contrast, in an examination of professional youth football academy coaches and players' skill-ratings over a period of 5 years, Hendry and colleagues (2018) found that while ratings of top players were positively related to practice, they were negatively related to the proportion of play vs practice. Hours spent in play were not correlated with ratings of any skill, including creativity. The authors concluded (2018, p. 7) that "there may be benefits to participation in coach-led practice and play from an early age, potentially due to the need to accumulate a high volume of sport-specific activity, as well as sufficient variations in practice".

Despite some studies highlighting a more pronounced influence of deliberate practice or deliberate play on creative development, most authors (e.g. Memmert, Baker & Bertsch, 2010; Bowers et al., 2014) concur that the combination of both strategies may be essential in the development of sporting creativity. This is further supported by work developed by Richard, Abdulla, and Runco (2017), who explored the influence of skill level, experience, and hours of sport training and participation on everyday creativity (e.g. divergent thinking related to diary and distraction management, creative attitude and values) on a sample of 208 Canadian athletes (21 intermediate, 73 advanced, and 114 experts, including Olympic and world-class competitors) aged between 14 and 37, across 17 different sports. Richard and colleagues found that expert athletes displayed a significantly higher cognitive flexibility, while athletes who

499 engaged in a higher number of sports were significantly more creative in comparison to
500 those who only practised one sport.
501 Finally, having explored the early life experiences of former NBA star Steve
502 Nash, Martin and Cox (2016) found other factors that may have contributed to Nash's
503 creative development: parental influence, intrinsic motivation, peer support, and self-
504 determination. Bowers and colleagues (2014) suggest that improving creativity does not
505 require "a complete reimagining of entrenched youth sport development models"
506 (p.325)" but could be achieved through the redistribution of time allocated to each
507 activity.
508
509 *Social priming*
510 To date, only one study (Furley & Memmert, 2018) has examined the impact of
511 social priming, i.e. the use of world-class creative players as role models, on creative
512 thinking. This study, with amateur adult football players, demonstrated that asking
513 participants to write down the characteristics of the creative player (e.g., Lionel Messi)
514 and imagine a typical situation that this player would be involved in led to more creative
515 responses to attacking scenarios. Furley and Memmert concluded that it is possible to
516 prime creative thinking in football players, by activating "cognitive representations of
517 creativity which in turn can activate associated mindsets, information processing modes,
518 and response tendencies" (2018, p.7).
519 *Programmes for the development of creativity*
520 While much of the research on sporting creativity has focused on isolating traits
521 and processes, there have been recent efforts to provide macro-structures (e.g.
522 frameworks, programmes) for the development of creativity. Three such programmes
523 are the Tactical Creativity Approach (Memmert, 2015), the Creative Development
524 Framework (CDF), which includes the Skills4Genius programme (Santos et al. 2016)

and The Creative Soccer Platform (TCSP) (Rasmussen & Østergaard, 2016). Preliminary research, although limited, suggests these programmes do develop sporting creativity.

The Tactical Creativity Approach (TCA) is the result of Memmert's extensive research on sporting creativity and represents the translation of his key findings into an operational framework. The TCA (Memmert, 2015) is composed by 6 D's: deliberate-play, 1-dimension games, diversification, deliberate coaching, deliberate motivation, and deliberate practice. Memmert (2015; 2017) proposes that special emphasis is placed on the first four D's during earlier stages of player development. Deliberate play and deliberate coaching relate to unstructured play without coaches or teachers actively providing instructions to players, in order to allow the latter to come up with multiple different solutions while keeping a wide attentional focus. 1-dimension games are basic game forms specifically aimed at improving tactical components. They are based on "clearly defined games ideas, fixed number of players, and defined rules and environmental conditions" (Memmert, 2015, p.51). Diversification refers to the contact with different sports and different stimuli within the same sport (e.g. playing with balls of different sizes, shapes, and materials in football). At more advanced stages of player development, Memmert (2015) highlights the importance of deliberate motivation and deliberate practice. With regards to the former, the TCA favours promotion instructions, which according to earlier research by Memmert, Hüttermann, and Orliczek (2013), may favour creative expression. Finally, the later can be developed through sport-specific, task-centred practice "to explore seldom but adequate solutions" (p.96).

The Creative Development Framework (CDF) is another model for the long-term development of creative behaviour in team sports. Development is divided into five stages where free-play and diversification are encouraged at the earlier stages of

550 youth development, advocating a transition to specialisation that is completed around
551 the age of 16. The CDF puts an emphasis on fundamental movement skills (Smith,
552 2014), fundamental game skills (Smith, 2014), non-linear pedagogy (Chow, 2013),
553 differential learning (Schöllhorn et al., 2009), teaching games for understanding (Tan,
554 Chow, and Davids, 2012), and constraints-led approach (Hristovski et al., 2011), as
555 ways of developing creative behaviour in sport. One of the key aspects of this model is
556 the belief that sporting creativity does not depend solely on skill mastery, but also relies
557 on the ability to think creatively.
558 The CDF has been partially tested ('Explorer' phase only – Skills4Genius
559 programme) with Portuguese primary school children (Santos, Jimenez, Sampaio &
560 Leite, 2017). Findings suggest the programme leads to improvements in general creative
561 thinking, increased fluency, elaboration, and originality. Effects on motor skills are less
562 clear. However, improvements were demonstrated for in-game creativity (attempts,
563 fluency, and versatility). Another empirical study based on the CDF (Santos et al.,
564 2018) examined the impact of differential learning, with an emphasis on small-sided
565 games, as an enhancement strategy for creative behaviour in youth football. While the
566 control groups did not alter their practice routine, the experimental groups took part in a
567 differential learning program, with three 30-minute training sessions per week, taking
568 place at the beginning of their team's training session. The training programme involved
569 playing small sided games with a constant variation of conditions such as balanced and
570 unbalanced number of players, different balls, pitches with different shapes, and
571 numerous body constraints (e.g., visual occlusion, hands behind head). Creative
572 performance was assessed through the CBATS (Santos and colleagues, 2017). The
573 experimental group demonstrated a significant reduction in failed actions and increased
574 attempts and versatility.

The Creative Soccer Platform (TCSP) (Rasmussen & Østergaard, 2016), based on Byrge and Hansen's work (2009, 2014) in educational settings, has four pillars: task-focus, parallel thinking, lateral thinking, and no experienced judgement. The programme focuses on "establishing a creative environment (i.e. a playful atmosphere) by facilitating creative processes (i.e. soccer-specific creativity exercises) where players try to develop creative products (e.g. new feints, dribbles or first touches) and train their creative abilities (not fearing to make mistakes)" (p.9). The impact of the TCSP was assessed through a focus group with some players and an interview with the coach. Rasmussen and Østergaard (2016) identified some limitations such as initial resistance to change and the difficulty of operating in a hybrid system (after the 'creativity' training in the first half of the session, players resumed normal structured training). They found that experiencing a variety of actions with the ball during the creativity exercises increased the chances of players trying different actions in competitive matches.

*Creative coaches, creative players?*

To date, only two studies have examined coaches' perceptions of creativity and its development. Distributing open-ended questionnaires to Korean football coaches completing their C and B licenses, Oh, Joung, Kim, Choi, Kim and Sung (2010) found that coaches associated "unpredictability, adaptability, improvisation, and mediating" (2010, p.65) with football creativity and prioritised the promotion of fundamental skills and self-determination as tools for its development.

Moreover, coaches indicated a lack of knowledge on how to teach creativity and revealed that they used personal experiences to overcome that gap. This study also identified several barriers to the improvement of sporting creativity, such as autocratic coaching styles, a focus on results which put coaches under pressure to win matches, the

league systems, and a lack of appropriate training facilities. Leso, Dias, Ferreira, and Gama (2017) examined football coaches' perceptions of creativity and game intelligence through a questionnaire containing a set of closed questions. They found that coaches associated creativity with magical thinking.

## Discussion

The purpose of this paper was to critically examine the existing literature on sporting creativity, exploring conceptualisations of sporting creativity and methods recommended for its assessment and development. While the first paper reviewed dates from 1967, the last two decades have seen an exponential increase in the number of publications on sporting creativity. This review contributes to our understanding of sporting creativity by providing the first review of research on defining, assessing and developing creativity in sport.

A single definition of sporting creativity has yet to be universally accepted. Understanding what is meant by creativity is considered "the single most fundamental problem in the field" (Simonton, 2012, p.97). While there is an overall convergence on the general criteria that make an action creative (i.e., novel and useful), deciding on the appropriateness and novelty of an action or idea is invariably conditioned by both the context and the experiences and beliefs of those judging them. With regards to the context, what is valued in a given time and location will determine whether an action is indeed novel, surprising, and appropriate for a given situation. For example, even the most common actions performed by a handball player in Germany, where the sport is widely developed, are likely to be considered original by most of the British population, who are almost entirely unfamiliar to the sport. The degree of appropriateness or originality of an action depends on who is judging it and on his/her previous

experiences. For example, a football coach that favours positional attacking may consider the Spanish style of playing *tiki-taka* a useful strategy, while another, favouring a direct game, may disagree.

The use of experts has been proposed and widely adopted to mitigate the relativism of evaluations, – including in sporting creativity (e.g. Memmert, Hüttermann, & Orliczek, 2013; Torrents et al., 2016; Hendry et al., 2018). This solution is criticised by Runco and Chand (1994), who question why expert ratings should deserve higher credit than self-reported, peer or teacher evaluations. However, it must be recognised that coaches and scouts are central figures in the identification and development of creativity in sport, having key roles in shaping players' experiences and opportunities. Future research focused on the evaluation of creative behaviour in sport should consider extending the use of expert ratings beyond the criteria of originality (current practice), to include the assessment of adequateness of solutions as well.

Conceptualisations of creativity must also be clear about the social-cultural context in which the action takes place and provide detailed justifications on the choice of judges, as these elements influence what is deemed creative. Stein's (1953 in Runco & Jaeger, 2012) definition of creative work - "a novel work that is accepted as tenable or useful or satisfying by a group in some point in time" (p.94) could be used to upgrade the existing definition of tactical creativity coined by Memmert (2011). This definition should also consider both attacking and defensive play, and the interdependence between attackers and defenders.

A constructive alignment between definitions of creativity and research methods used to assess creativity should be considered. The use of game-based situations has improved ecological validity, albeit in quasi-naturalistic settings (researcher-controlled, non-competitive). Definitions of creativity operationalised through these assessments

649 should also be reconsidered (e.g., creativity only occurs in attacking play), together with
650 potential limitations to creative expression 'imposed' on participants through task
651 design, e.g., inferiority vs superiority of numbers in games.
652 Because of the clear influence of cognitive traditions in much of the research on
653 creativity in sport, creativity definitions and evaluations have privileged the thought
654 process over the ability to act, limiting the understanding of *doing* (performance) as an
655 integral feature of sporting creativity. Performance, real-time expression, and a reliance
656 on the brain's implicit system suggest that creativity should be conceptualised as 'in
657 sport' - in action - rather than 'about sport' and assessed and developed accordingly. If a
658 driver for examining sporting creativity is the desire to increase unpredictability in
659 performance and therefore a competitive advantage, then the final product of the
660 creative process - performance of the creative action - ought to be a critical feature of
661 how creativity is conceptualised.
662 With regards to developing sporting creativity, research is advancing towards
663 more integrative approaches that can be implemented over an extended period and
664 accompany players' developmental journeys. However, despite encouraging initial
665 results, more research is needed to evaluate the long-term effects of these programmes
666 on creativity due to creativity developing over a long period (Memmert & Roth, 2007).
667 Furthermore, while Memmert's TCA (2015) proposes a holistic framework, creativity
668 training in both the CDF and TCSP was limited to a small part of training sessions.
669 Future research could explore the effects of programmes in settings that do not treat
670 creative training as an appendix or an isolated section of a session but instead adopt the
671 philosophical underpinnings of creative development as an orienting matrix for the
672 whole session planning, delivery and reflection.

673 A much more detailed description of the tasks executed by players during
674 training programmes is needed, to allow for more accurate categorisation of what
675 constitutes deliberate practice and deliberate play. The way both concepts are depicted
676 in existing research is too broad. Also, participant sampling could be more consistent to
677 increase the validity of findings. For example, in Memmert, Baker, and Bertsch's
678 (2010) study direct comparisons were made between players with different roles -
679 attackers and defenders - who occupy different areas of the pitch and perform different
680 actions, which may have had an impact on results. It must also be recognised that while
681 important, strategies like deliberate practice or deliberate play are merely partial
682 influences in the overall development of children. For example, in Bowers and
683 colleagues' (2014) work, sporting activities accounted for only 30% of the total leisure
684 time of participants. Consequently, interdisciplinary and multi-dimensional approaches
685 that look beyond the sporting arena are recommended, to establish a more complete
686 description of the development of creativity across the lifespan.
687 The existing literature indicates that sporting creativity can be trained. It does
688 not, however, support a single strategy for its development. So far, a balance between
689 deliberate practice and deliberate play appears likely to be advantageous. Social priming
690 may also be a promising avenue for future research to further our understanding of how
691 creativity is developed. Some programmes for the enhancement of sporting creativity
692 have been recently proposed (e.g. CDF, TCSP) and, although limited, the evidence does
693 support their effectiveness. However, which of the many features of these programmes
694 is responsible for creative development and why remains unclear. Developing this
695 understanding, however, will assist practitioners to implement programmes to develop
696 creativity. Also, while it is recognised that coaches have a pivotal role in the
697 development of sporting creativity, research involving them is still scarce. A potential

698 ‘cascade effect’ could be investigated, based on the assumption that more creative
699 coaches could develop more creative conditions and, consequently, more creative
700 players. Furthermore, Rasmussen, Østergaard, and Glăveanu (2017) have criticised a
701 perspective of sporting creativity that exclusively emphasises performance, in-game
702 benefits and technical expertise. They propose that creativity should be seen instead as
703 a developmental resource and argue that current performance-oriented visions may lead
704 to overlooking the broader educational benefits that may arise from simply taking part
705 in creative activities, such as increased self-confidence and self-esteem. Along similar
706 lines, Richard and colleagues’ (2017) showed that sport diversification and expertise
707 may improve everyday creativity.
708 Our review found that most of the research conducted, thus far, has employed
709 quantitative and experimental or quasi-experimental designs. Additional insight could
710 be gained from employing other methods such as observation, interviews, or
711 ethnographies to examine *in situ* creativity and its development. This will involve going
712 to the training environment as well as exploring the impact of the broader socio-cultural
713 milieu and personality on sporting creativity. Due to the relative nature of creativity and
714 the importance of domain-specific experts in its understanding and development, such
715 approaches should also engage practitioners (e.g. coaches, scouts) as active participants
716 in all stages of the research process.

717 **Conclusion**

718 This review has demonstrated the lack, as yet, of a widely accepted definition of
719 sporting creativity. We identified important considerations for the conceptualisation of
720 sporting creativity including the distinction between creative thinking (prominent in the
721 research) and creative action, context-specificity, and its emergent nature. The review
722 also demonstrated the influence cognitive conceptualisations of creativity have had on

how creativity is assessed, privileging assessment of creative thinking about sport over creative action. Some researchers are beginning to employ ecologically valid assessment (i.e., game-based situations), although these still have limitations often as a result of the definition of creativity that is operationalised. With regards to correlates of creativity, a small range of variables have been examined. Again, the privileging of cognitive definitions has seen attention and pattern recognition being the most commonly researched variables. The review also identified several strategies and programmes that have been proposed for the development of sporting creativity. These show some promise and suggest creativity is trainable, particularly when they include a combination of deliberate practice and deliberate play or less instruction from coaches thereby encouraging greater self-regulated learning. Much remains to be explored and understood about creativity, which presents a range of exciting opportunities for researchers to contribute to this area and further creativity in sport.

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Wallas, G. (1926). *The art of thought*. New York: Harcourt, Brace and Company. https://doi.org/10.1038/nature08284

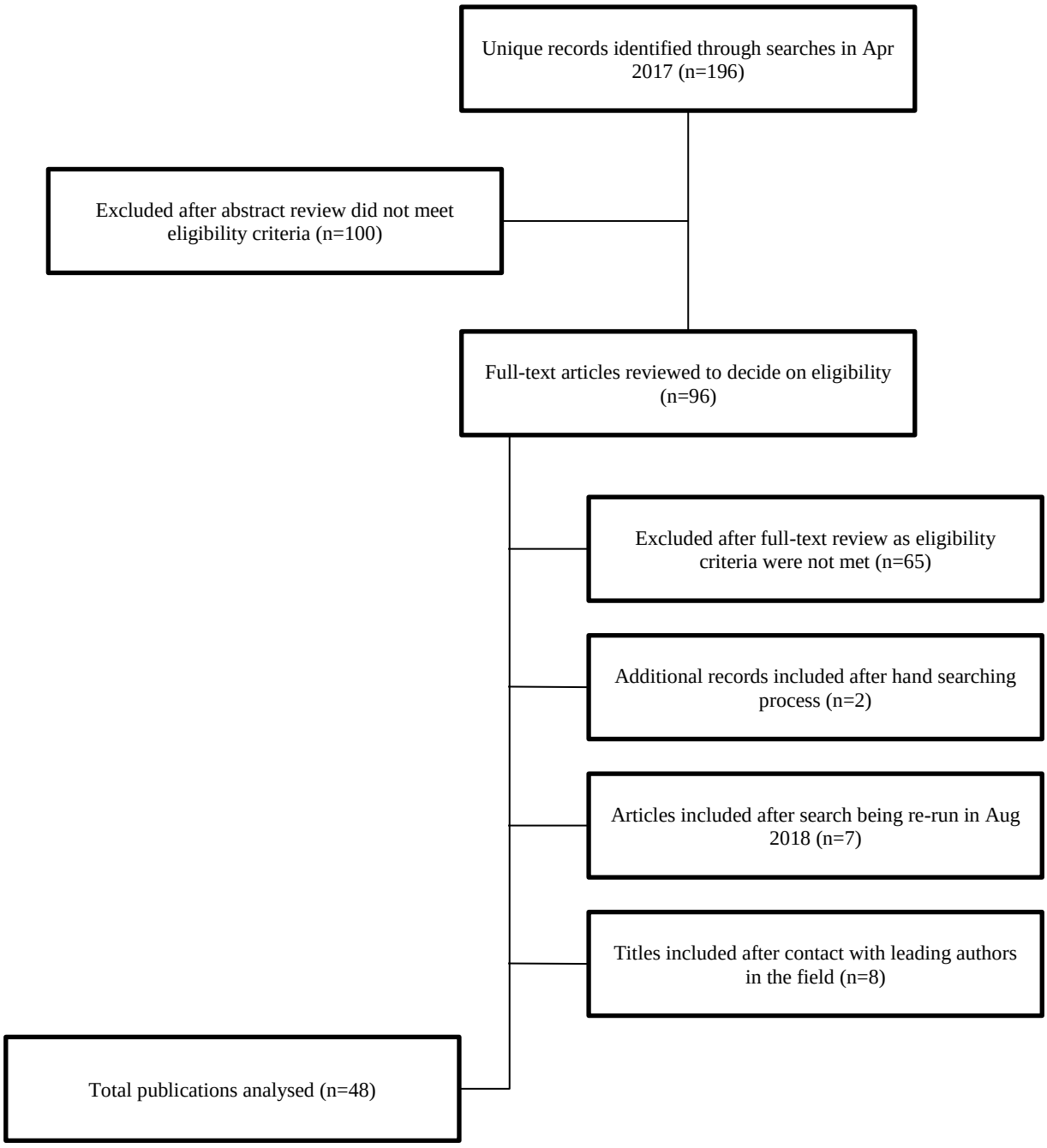


Figure 1: Selection process

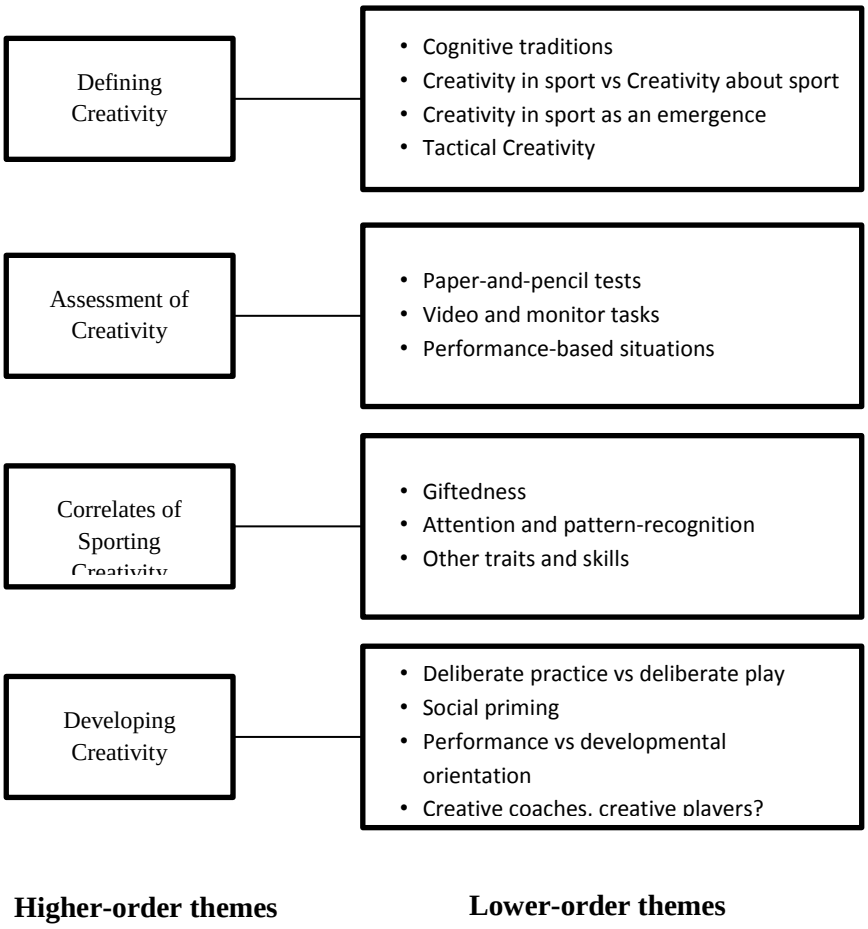


Figure 2: Distribution of higher and lower-order themes.

978 **Tables**

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|---|---|
| **Inclusion criteria (studies had to meet <u>all</u> criteria)** | a) Studies referred to sport, in general, or to team invasion games/rugby/court invasion games/court-divided games as defined by Launder & Piltz (2013)<br>b) Studies were published in peer-reviewed journals and/or conference proceedings and were directly related to creativity or its correlates;<br>c) Studies were original and published in languages spoken by the authors of this review (English, French, Italian, Portuguese, and Spanish). |
| **Exclusion criteria** | a) Non-peer-reviewed books or book chapters and dissertations were not considered due to lower peer-evaluation standards and difficulties in access;<br>b) Documents published by institutions with commercial affiliations (e.g. company foundations) were not included; |

979 Table 1: Inclusion and exclusion criteria

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| Author(s) | Year | Study Type | Participants | Country participants | Assessment of Creativity |
|---|---|---|---|---|---|
| Brown, G.; Gaynor, D. | 1967 | Position paper | n.a. | n.a. | |
| Ďuriček, M. | 1992 | Position paper | n.a. | n.a. | |
| Everhart, B.; Kernodle, M.; Turner, E.; Harshaw, C.; Arnold, D. | 1999 | Quantitative/ Experimental | 24 | USA | |
| Memmert, D. | 2006a | Quantitative/ Experimental | 2 experiments (Exp.1 - 33; Exp.2 - 112) | Germany | Game-test situations |
| Memmert, D. | 2006b | Quantitative/ Experimental | 48 | Germany | Game-test situations |
| Memmert, D.; Furley, P. | 2007 | Quantitative/ Experimental | 3 experiments (Exp.1 - 34; Exp.2 - 29; Exp.3 - 16) | Germany | |
| Memmert, D.; Roth, K. | 2007 | Quantitative/ Experimental | 135 | Germany | |
| Memmert, D. | 2009 | Quantitative/ Experimental | 55 | Germany | |
| Memmert, D.; Perl, J. | 2009 | Quantitative/ Instrument Validation | 42 | Germany | |
| Memmert, D. | 2010 | Quantitative | 195 | Germany | |
| Oh, J I; Joung, K; Kim, H. K.; Choi, H.; Kim, N.; Sung, J. | 2010 | Qualitative/ Survey | 52 | South Korea | |
| Greco, P.; Memmert, D.; Morales, J. | 2010 | Quantitative | 22 | Brazil | |
| Lacerda, T.; Mumford, S. | 2010 | Position paper | n.a. | n.a. | |

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|---|---|---|---|---|---|
| Memmert, D.; Baker, J.; Bertsch, C. | 2010 | Quantitative/ Survey | 72 | Germany | |
| Hopsicker, P. | 2011 | Position paper | n.a. | n.a. | |
| Aggerholm, K.; Jespersen, E.: Ronglan, L.T. | 2011 | Position paper | n.a. | n.a. | |
| Cavallera, G. M.; Boari, G.; Labbrozzi D.; del Bello, E. | 2011 | Quantitative/ Experimental | 61 | Italy | TTCT figural series (1989) |
| Memmert, D. | 2011 | Quantitative/ Experimental | 120 | Germany | Divergent Thinking Test (Krampen, 1996) – subtest + Video handball-specific divergent thinking |
| Veraksa, A. N.; Gorovaya, A. E. | 2011 | Quantitative/ Experimental | 31 | Russia | TTCT verbal and figural |
| Hristovski, R.; Davids, K.; Araujo, D.; Passos, P. | 2011 | Position paper | n.a. | n.a. | |
| Hristovski, R.; Davids, K.; Araujo, D.; Passos, P. | 2012 | Position paper | n.a. | n.a. | |
| Memmert, D.; Hüttermann, S.; Orliczek, J. | 2013 | Quantitative/ Experimental | 30 | Not reported | Video soccer-specific divergent thinking |
| Bowers, M. T.; Green, B. Ch.; Hemme, F; Chalip, L. | 2014 | Quantitative/ Survey | 99 | USA | Abbreviated Torrance Test for Adults (ATTA) |
| Campos, D. | 2014 | Position paper | n.a. | n.a. | |
| Furley, P.; Memmert, D. | 2015 | Quantitative/ Experimental | 61 | Germany | Video soccer-specific divergent thinking |
| Memmert, D. | 2015 | Academic Book | n.a. | n.a. | |

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|---|---|---|---|---|---|
| Rasmussen, L.; Østergaard, L. | 2016 | Mixed methods/ Experimental | 15 players + 1 coach | Denmark | |
| Igorov, M.; Predoiu, R.; Predoiu, A; Igorov, A. | 2016 | Quantitative/ Experimental | 11 | Unreported | Imagination and Creativity Test (Roco, 2004) – first task only |
| Torrents, C.; Ric, A.; Hristovski, R.; Torres-Ronda, L.; Vicente, E.; Sampaio, J. | 2016 | Quantitative/ Experimental | 44 | Unreported | Small-sided games |
| Arslan, K. S.; Akpunar, F.; Ulucan, K. | 2016 | Position paper | n.a. | n.a. | |
| Harrison, C. | 2016 | Qualitative/ Auto-ethnography | 1 | Australia | |
| Moraru, A.; Memmert, D.; van der Kamp, J | 2016 | Quantitative/ Experimental | 2 experiments (Exp.1 - 57; Exp.2 - 56) | Unreported | |
| Santos, S. D. L.; Memmert, D.; Sampaio, J.; Leite, N | 2016 | Position paper | n.a. | n.a. | |
| Martin, J.; Cox, D. | 2016 | Qualitative/ Biographical | Multiple | Canada/USA | |
| Tanggaard, L.; Laursen, D.; Szulevicz, T. | 2016 | Qualitative/ Material Biography | n.a. | n.a. | |
| Santos, S.; Jiménez, S.; Sampaio, J.; Leite, N. | 2017 | Quantitative/ Experimental | 40 | Portugal | TTCT – figural version + small-sided games (GK+3v3+GK) |
| Ilundain-Agurruza, J. | 2017 | Position paper | n.a. | n.a. | |
| Rasmussen, L.: Østergaard, L.; Glaveanu, V. | 2017 | Position paper | n.a. | n.a. | |

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|---|---|---|---|---|---|
| Leso, G.; Dias, G.; Ferreira, J. P.; Gama, J.; Couceiro, M. S. | 2017 | Quantitative/ Survey | 34 coaches + 118 players | Portugal | |
| Orth, D., van der Kamp, J.; Memmert, D.; Savelsbergh, G. | 2017 | Position paper | n.a. | n.a. | |
| Memmert, D. | 2017 | Book chapter | n.a. | n.a. | |
| Richard, V.; Abdulla, A.M; Runco, M. | 2017 | Quantitative/Experimental | 208 athletes (94 males, 114 females) | Canada | Runco Creative Assessment Battery |
| Santos, S.; Coutinho, D.; Goncalves, B.; Schollhorn, W.; Sampaio, J.; Leite, N. | 2018 | Quantitative/ Experimental | 40 | Portugal | Small-sided Games (GK+5v5+GK) |
| Hendry, D.; Williams, A.M.; Hodges, N. | 2018 | Quantitative/ Survey | 102 | UK | |
| Furley, P.; Memmert, D. | 2018 | Quantitative/ Lab-based Experiment | 120 (39 women) players | Germany | |
| Kempe, M.; Memmert, D. | 2018 | Quantitative/ Match-analysis | 153 games, 311 goals | Worldwide | |
| Roca, A.; Ford, P.; Memmert, D. | 2018 | Quantitative/ Experimental | 44 male players | England | Life-size soccer-specific divergent thinking |
| Hüttermann, S.; Nerb, J., Memmert, D. | 2018 | Quantitative/Experimental | 30 male players | Germany | Video-based divergent thinking task |

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