Developmental activities in the acquisition of creativity in soccer players

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Abstract

We examined whether high- or low-creative soccer players who were classified based on an established soccer-specific creative decision-making test differed based on their participation history profiles. Their solutions on the test were measured using the three observation criteria for creativity of originality, flexibility, and fluency of decisions. Questionnaires were used to record the participation history profiles of players. The high-creative group spent significantly more average hours per year in free, unstructured soccer-specific play activity during childhood and early adolescence (i.e., 6-15 years of age) when compared with their low-creative counterparts. No differences were reported for hours per year in soccer-specific formal practice and competition between the two groups across development. Moreover, hours accumulated in other sports, as well as milestones achieved, did not differentiate groups. Our findings suggest that informal unorganized, free play in the primary sport is positively associated with and necessary for the development of superior levels of creative ability in soccer players. Practical implications, further research avenues and limitations are presented.

Keywords: *Creative decision making; Sport expertise; Player development; Skill acquisition; Deliberate play; Deliberate practice*

Introduction

The most skilled professional soccer players create excitement for spectators when they touch the ball because they often produce outstanding decisional actions during match play. The ability of players to produce relatively novel solutions in game situations that are both original (i.e., statistically rare and surprising) and appropriate (i.e., useful, adequate) is defined as 'tactical' creativity (Memmert & Roca, 2019). For the purpose of this investigation, we will focus on this type of creativity as it plays a significant role in team ball sports like the game of soccer used in this study. Yet, very few researchers have studied how this type of creative behavior is acquired and developed in the sporting domain (e.g., Henry, Williams, & Hodges, 2018; Memmert, Baker, & Bertsch, 2010). We address this shortcoming in the literature by assessing the activities that contribute to the development of superior creativity by examining differences in participation history profiles of skilled soccer players who are classified as either high- or low-creative players based on their performance on a soccer-specific creative decision-making test.

Over the past two decades, researchers have largely been influenced by the theory of Deliberate Practice (Ericsson, Krampe, & Tesch-Römer, 1993) to examine the development and acquisition of expert decision making and performance. The main proposition that the amount of domain-specific deliberate practice accumulated in by individuals during their careers is positively correlated to their attained level of performance has defined several studies across various fields, including sport (for a review, see Macnamara, Moreau, & Hambrick, 2016), music (Ericsson et al., 1993), and medicine (van de Wiel, Van den Bossche, Janssen, & Jossberger, 2011). The characteristics of deliberate practice are that is a highly structured activity with the primary goal of improving an aspect of current performance, coach-led, individualized,

effortful, and relatively low in intrinsic enjoyment. The importance of deliberate practice has been widely recognized as a key component to the development of sport expertise (e.g., Baker & Young, 2014), however, it has likewise been criticized for being overly simplistic and not accounting for the multidimensional nature of athlete development (Hambrick et al., 2014; Macnamara et al., 2016). Over the past few years, some researchers (Berry, Abernethy, & Côté, 2008; Roca, Williams, & Ford, 2012; Williams, Bell-Walker, Ward, & Ford, 2012) have examined whether athletes with varying levels of expert decision making and performance may be differentiated based on their participation history profiles. Participants in these studies recall their practice history via interviews or questionnaires. They started engagement in the primary sport in early childhood (i.e., 5-7 years of age) and participated in several different activities throughout their development, including deliberate practice, free play, and competition. Some between-group differences revealed that the higher-performing groups accumulated more hours in free play activity in their primary sport of soccer (Roca et al., 2012; Williams et al., 2012) or in different invasion sports generally (Berry et al., 2008), particularly during their childhood period (e.g., 6-12 years of age). This provides evidence that engagement in play (e.g., informal games set-up by the children themselves, such as street soccer or backyard basketball; see Côté, Baker, & Abernethy, 2007) in combination with deliberate practice is an important antecedent to the development and attainment of sporting expertise in team ball sports.

Although the ability to think creatively may be seen as an important characteristic of expert decision making (e.g., tactical intelligence), these are often seen as not the same. This difference may be based on the theoretical distinction between 'divergent thinking' and 'convergent thinking' (Guilford, 1967; Memmert et al., 2010). Convergent thinking is associated to the ability to find the best solution to a given

problem, while divergent thinking refers to the ability to produce a variety of solutions that are innovative, rare, unusual and, original (Sternberg & Lubart,1999). Nevertheless, recent research (Dietrich & Haider, 2017) suggests that convergent thinking can also contribute to creative insights and that it should be similarly considered as a measure of creative ability when assessing creativity in sporting environments. Likewise, adding a convergent thinking measure might allow for a more realistic assessment of sporting creativity (i.e., players in a game can only select and execute a response at a time to each game situation encountered).

In line with research conducted on expert decision making, few researchers (Greco, Memmert, & Morales, 2010; Henry et al., 2018; Memmert et al., 2010) have attempted to explore the role of different developmental activities (i.e., deliberate practice and play) on the acquisition of sport-specific creativity. Greco et al. (2010) evaluated whether tactical creativity in youth basketball players might be improved by using either a sport-specific deliberate-play or a more traditional structured training program. Findings showed significant training improvement on measures of tactical intelligence and creativity for the deliberate-play group only. Memmert and colleagues (2010) conducted the first study using retrospective recall questionnaires to identify the role of different practice activities in the development of creative behavior in team ball sports. Twelve coaches selected the most and least creative players from their teams (soccer, basketball, field hockey, and team handball). Participants completed the participation history questionnaire designed to gather information about the quantity and type of sport-specific and other related practice activities undertaken throughout their careers. Findings revealed that the highly creative players accumulated more hours in free, unstructured play activities in their main sport compared with their less-creative counterparts, particularly between the ages of 5-14 years. Participants also engaged on

119 average in three to four other sports throughout their development. More recently,
120 Henry et al. (2018) used participation history questionnaires and coach ratings of
121 technical, tactical, physical, and creative skills to examine the relationship between
122 developmental soccer activities and skill evaluations over a period of 5 years. They
123 found that while structured, sport-specific practice was positively related to the
124 development of skills, hours in soccer play did not show expected correlations with
125 ratings of any skill, including creativity. The authors advocated that there may be
126 benefits to involvement in deliberate practice and play from an early age, given the need
127 to accumulate a high amount of sport-specific activity, together with sufficient
128 variations in practice.

129 Despite some research (e.g., Henry et al., 2018; Memmert et al., 2010) stressing
130 more for the contribution of coach-led practice or play to the acquisition of superior of
131 sport-specific creativity, authors agree that a blend of both may perhaps be vital to the
132 development of creativity in sport. While research supports the importance of domain-
133 specific expertise in creativity (Baer, 2015), evidence also exists that engagement in
134 other sports during development can similarly create opportunities for athletes to
135 develop perceptual-cognitive skills that potentially transfer across sports containing
136 similar cognitive processing and relational/tactical elements (e.g., soccer to basketball
137 and vice versa; see Abernethy, Baker, & Côté, 2005; Causer & Ford, 2014; Roca &
138 Williams, 2017).

139 While some researchers (Henry et al., 2018; Memmert et al., 2010) provided
140 initial attempts in the literature to investigate the role of practice conditions on the
141 development of domain-specific creativity in sports, these investigations had some
142 limitations. The studies relied on the subjective judgments of coaches to rate the tactical
143 creativity ability of each of their own players, which may be prone to systematic biases,

such as the coach-player relationships or the player's personality (for a review, see Ericsson, 2003). The classification of players' skills' levels based on subjective criteria may compromise the validity of the results by leading to players being classified incorrectly. Ericsson (2003) states that researchers should attempt to evaluate task performance using objective measures (i.e., the task employed should provide precise and reproducible measurements so that the performance can be objectively evaluated). For example, by using a representative sport-specific creativity test, performance on the task can be measured more accurately such that (groups of) athletes with varying levels of domain-specific creativity may be compared under more standardized and reproducible test conditions.

In the present study, we examine whether skilled soccer players who are classified as either high- or low-creative players based on their performance on a representative soccer-specific creativity test, can be differentiated based on their engagement in soccer and sport activities during their development. We used retrospective recall questionnaires to collect participation history data for both groups. We predicted that the high-creative players would have accumulated more hours in soccer-specific activity throughout their development (i.e., 6-18 years of age) when compared with the low-creative players (e.g., Henry et al., 2018; Memmert et al., 2010; Roca et al., 2012). We further expected, based on the findings of Memmert et al. (2010), that the average number of hours per year spent in soccer unstructured play during childhood and early adolescence (i.e., 6-15 years of age) would be greater for high-creative compared to low-creative players.

Methods

Participants

Participants were 48 skilled, male outfield soccer players (*M* age = 20.2 years, *SD* = 2.1). Players were recruited from a range of different semi-professional and professional soccer clubs in the south-east of England. Seventeen of all participants were currently playing or had played soccer at a professional level. Written informed consent was obtained from the participants prior to taking part in the study and all participants had a right to withdraw at any point. The experiment was conducted in accordance with the 1964 Declaration of Helsinki and approval was obtained from the authors' University Research Ethics Committee.

Procedure

Soccer-specific creativity test. Participants were presented with a representative task involving video sequences of dynamic 11 vs. 11 attacking situations that offered a range of multiple decision options for the player in possession of the ball at the time of video occlusion. Further details on the production of the test film are reported elsewhere (see Roca, Ford, & Memmert, 2018; 2021). The test comprised of 20 video clips of approximately 10 s duration that were occluded at a key moment in the action. Immediately prior to occlusion the player in possession of the ball on the video had a variety of possible tactical options, including different attacking passes, shooting at goal, or dribbling forwards. The order of presentation of the clips was the same for all participants.

The video clips were projected onto a large white wall (image size: height 2.5 m and width 3.4 m) using an LCD projector (Epson EB-X31, Tokyo, Japan). Participants started each trial in a standing position at 3m from the video screen wall. A soccer ball (Mitre Cyclone indoor size 4 ball) was directly in front of them on each trial. They were required to imagine themselves as the attacking player in possession of the ball on the

video. Considering that to attain a more comprehensive measure of creative ability convergent and divergent thinking may be mutually considered (Dietrich & Haider, 2017), a convergent thinking measure was also included in our soccer-specific creativity test (i.e., participant required to select and execute a tactical decision by physically playing the ball in response to each presented scenario as quickly as possible as the screen occluded). Moreover, such methodological approach enhances the 'real-world' representativeness and fidelity of participant decision making on the task by allowing participants to respond similarly to as they would in a real-game situation (e.g., Roca, Williams, & Ford, 2014). They also had to verbally confirm their decision immediately after executing the action, which would be either to whom and how they intended to pass the ball, if they shot at goal or dribbled the ball forward. This approach contrasts with the methodological norm in research on sport creativity where divergent thinking tasks have been predominant (for a review, see De Sá Fardilha & Allen, 2020). After this, the last still frame of the video clip was shown for 45 s during which time the participants were required to generate all other adequate tactical solutions they would or could execute for that situation (divergent thinking) (for the transcript on instructions given to participants, see 'Supplementary material 1', Roca et al., 2021, p. 7). The same procedure was employed across every single trial. In order to offer participants a more naturalistic and immersive sensation to the task, the real ambient crowd noise of the stadium was played through multimedia stereo speakers (Logitech Z200, Lausanne, Switzerland) during testing. Participants first completed three warm-up trials for pre-test familiarization. The testing for each participant took about 45 min. After completing the testing procedure participants were informed about the purpose of the experiment.

Participation history questionnaire. The Participation History Questionnaire (PHQ) was used to elicit information relating to the developmental activities undertaken by players. Indices associated to the reliability and validity of the PHQ have previously been reported (e.g., Ford, Low, McRobert, & Williams, 2010) and its use is relatively widespread (e.g., Ford et al., 2010, 2020; Roca et al., 2012; Williams et al., 2012). The questionnaire contains three sections. The first section of the questionnaire elicited information on soccer-specific milestones. Participants were required to record the age at which they first took part in any soccer, supervised training in soccer with an adult, organized soccer league, youth development training program, semi-professional and/or professional soccer. The second section recorded information on their engagement in soccer activities. Three soccer activities were examined: practice, play, and competition. These activities used were based on previous research in which retrospective questionnaires were used (e.g., Roca et al., 2012: Ward, Hodges, Starkes, & Williams, 2007) and to match the recommendations proposed by Côté, Ericsson, and Law (2005). Practice referred to soccer activity undertaken alone or in a group under the supervision of coaches or adults in which the intent is to improve performance (e.g., practice with team). Play activities referred to play-type games with rules supervised by participants themselves in which the intent is enjoyment (e.g., "kick around" with friends). Competition included time spent playing organized competitive matches against another team in which the intent is to win (e.g., league games). Participants recorded the number of hours per week and the number of months per year spent in each of the soccer activities. Additionally, they recorded in weeks any time away from soccer (i.e., injured and unable to participate) that occurred across the course of the season. Soccer-specific information was reported retrospectively for the present season/year, then working backwards in two-year intervals until the age they first started playing soccer.

The third section of the questionnaire recorded information on engagement in other sport activities. Participants were provided with a comprehensive list of sports and were required to indicate those they had taken part in on a regular basis (i.e., a minimum period of three months in total), excluding school physical education classes. Any sports that were not on the list could be added by participants to the end of the list. They were required to provide the age at which they started playing each sport, the number of hours per week and the number of months per year they had spent in each sport, and the age they finished taking part in each sport (unless they were still involved in the sport).

Questionnaires were completed individually at a desk in the laboratory and under supervision of the main experimenter. Participants were instructed on how to complete each section of the questionnaire before commencing that section. For the second section, participants had to specify the team and coach that they played for in each age group during their development to aid memory recall of the hours in the soccer activities (e.g., Ford et al., 2020). Participants completed the questionnaire in approximately 1 hr.

Creativity data analysis

Creative performance on the soccer-specific creativity test was measured using the three criteria *originality*, *fluency*, and *flexibility*. These measures have been part of a standard procedure repeatedly used to assess athletes' creative performance in previous research (for a review, see Memmert, 2015). *Originality* referred to the production of responses that are rare or a-typical according to the norm. Three independent experts (qualified UEFA soccer coaches) judged the originality of the solutions given by participants for each scene using a Likert scale ranged between 1 (not original at all) to 5 (very original). The inter-rater reliability between coaches for originality measure was above the critical limit of 0.80 (intraclass correlation coefficient). The first decision

made by the participant in a trial was analyzed separately because it was the most realistic decision-making response akin to that made in a real-match situation (i.e., Roca et al., 2018; 2021). These ratings were used to compute two mean originality scores for each participant, one for the first initial response (convergent thinking) and another for the responses given when the last frame was shown afterwards for 45 s (divergent thinking) (summed ratings for each response were divided by the total number of responses). *Fluency* was measured by the number of appropriate tactical solutions produced by a participant per trial. *Flexibility* was assessed by diversity of responses. All solution options given by the participants were categorized based on Roca et al. (2018: short pass, lofted pass, through ball, wall pass, back heel pass, outside of the foot pass, feinting, turn, crossing, dribbling, shot at goal). A point was awarded for each category selected by a participant and summed for the respective trial, before being divided by the total number of trials to establish a flexibility score for each participant.

Each of the four components (originality of initial response, originality, fluency, flexibility) were analyzed separately followed by averaging the z-transformed values of each component into a merged creative performance score for each participant as per previous creativity research (cf. Furley & Memmert, 2015; Hüttermann et al., 2018; Memmert et al., 2013). A quartile-split approach was employed as an objective method for stratifying participants into significantly different sub-groups based on players' creative performance scores (total, z-value) from the soccer-specific creativity test (e.g., see Ford et al., 2010; Roca et al., 2018; Williams et al., 2012). The top 12 ranked players were classified as 'high creative', whereas the 12 players with the lowest creativity scores were classified as 'low creative'. A priori power analysis was conducted using G*power (Faul, Erdfelder, Lang, & Buchner, 2007). Calculations were based on the main effect sizes for creative performance response scores reported by

Roca et al. (2018, 2021) who employed the same task and skill-based groups and using the lower between-factor effect size (d = 1.68) and power of 0.95, the total sample size required was 18 participants. Response scores for originality of initial response, originality, fluency, flexibility, and the total creativity score were analyzed using independent *t*-tests between the high- and low-creative groups.

Participation history data analysis

Participation history data were analyzed for the high- and low-creative groups. First, the milestones data were analyzed separately using independent *t*-tests between groups. Second, the accumulated hours in soccer activity were recorded for every other year between the current season and start age, so linear interpolation was used for the missing years (i.e., average of the year preceding and succeeding). These hours were split into two age periods (i) 6-12 years (i.e., childhood) and (ii) 13-18 years (i.e., adolescence) for practice, play, and competition. The number of hours per year was calculated by multiplying hours reported per week by weeks per year, minus weeks players reported being injured and unable to participate. The number of weeks per year was based on a 40-week season for soccer practice and competition activities. Separate 2 Group (High-creative, Low-creative) × 3 Activities (Practice, Play, Competition) ANOVAs with repeated measures on the last factor were performed for (i) 6–12 years and (ii) 13–18 years of age. Any significant main effects were followed up with pairwise comparisons. The Bonferroni correction method was used to adjust the alpha level required for significance for post hoc pairwise comparisons only. Finally, we also conducted separate independent *t*-tests for the number of other sports and hours accumulated in other sports for these two age ranges between groups.

The Greenhouse-Geisser and Huynd-Feldt corrections were employed in the case of violations of Mauchly's test of sphericity (Girden, 1992). Effect sizes are

reported using partial eta squared (η_p^2) in all instances and Cohen's *d* for comparisons between two means. The alpha level (*p*) required for statistical significance was set at .05 for all tests.

Results

Creativity test

The high-creative group ($M_{Creativity\ score}$ = 1.00 ± 0.32) recorded a significantly higher creative performance score on the test compared with the low-creative group ($M_{Creativity\ score}$ = -0.87 ± 0.34), $t(22) = 13.95$, $p < .001$, $d = 5.66$. For the different components of creativity, the high-creative players produced more original decisions for the initial response ($M_{Originality\ 1st\ response}$ = 3.30 ± 0.33), $t(22) = 5.39$, $p < .001$, $d = 2.19$, and for the responses given when the last frame was shown ($M_{Originality}$ = 2.77 ± 0.17), $t(22) = 4.15$, $p = .001$, $d = 1.71$, as compared to the low-creative group ($M_{Originality\ 1st\ response}$ = 2.60 ± 0.31, and $M_{Originality}$ = 2.47 ± 0.18, respectively). Also, the high-creative group made more appropriate ($M_{Fluency}$ = 3.06 ± 0.23), $t(22) = 8.27$, $p < .001$, $d = 3.37$, and flexible ($M_{Flexibility}$ = 2.92 ± 0.32), $t(22) = 8.54$, $p < .001$, $d = 3.46$, tactical solutions when compared with the low-creative group ($M_{Fluency}$ = 2.25 ± 0.25, and $M_{Flexibility}$ = 1.94 ± 0.24, respectively).

Participation history data

Milestones. The descriptive and inferential statistics for milestones between groups are presented in Table 1. There were no differences between the high- and low-creative groups for their chronological age or for any of the milestones. Furthermore, we analyzed the participants' current playing positions with the high-creative group being comprised of three defenders, seven midfielders, and two attackers and the low-creative group of four defenders, three midfielders, and five attackers.

Insert Table 1 about here

Soccer activity. The total hours accumulated in soccer activity by 18 years of age differentiated the high- from the low-creative group, $t(22) = 2.55$, $p < .05$, $d = 1.04$. The high-creative group ($M = 6589.6 \pm 1975.9$ h) accumulated more hours in soccer compared with the low-creative group ($M = 4717.5 \pm 1599.6$ h). Figure 1 presents the average hours per year in soccer activities between 6 and 18 years of age for the high- and low-creative groups.

Insert Figure 1 about here

There was a main effect for activity in childhood, $F(2, 44) = 41.89$, $p < .001$, $\eta_p^2 = .66$. *Post-hoc* tests showed that the average hours per year during childhood in soccer play activities ($M = 288.6 \pm 182.4$ h $\cdot$ year $^{-1}$) was higher compared with soccer-specific practice ($M = 91.6 \pm 65.7$ h $\cdot$ year $^{-1}$) and competition ($M = 42.0 \pm 21.6$ h $\cdot$ year $^{-1}$) (both p's $< .001$). There was a main effect for group, $F(1, 22) = 4.34$, $p < .05$, $\eta_p^2 = .17$, and a significant Group x Activity interaction, $F(2, 44) = 4.51$, $p < .05$, $\eta_p^2 = .17$. *Post-hoc* tests showed that the high-creative group spent significantly more average hours per year during childhood in soccer-specific play activity when compared with their low-creative counterparts ($M = 366.6 \pm 194.0$ h $\cdot$ year $^{-1}$ vs. $M = 210.5 \pm 136.6$ h $\cdot$ year $^{-1}$, $p < .05$, $d = 0.93$) (see Figure 1).

There was a main effect for activity in adolescence, $F(1.70, 37.43) = 12.55$, $p < .001$, $\eta_p^2 = .36$. *Post-hoc* tests showed that the average hours per year during adolescence in soccer-specific practice ($M = 206.3 \pm 109.2$ h $\cdot$ year $^{-1}$) and play activities ($M = 151.0 \pm 91.9$ h $\cdot$ year $^{-1}$) were higher compared with competition ($M =$

92.5 ± 33.9 h · year $^{-1}$) (both p's < .01). There was no main effect for group, $F(1, 22) = 3.47$, $p = .076$, $\eta_p^2 = .14$, and the Group x Activity interaction approached significance, $F(1.70, 37.43) = 3.21$, $p = .059$, $\eta_p^2 = .13$. To test our a priori prediction that the high-creative group would spend on average more time per year in soccer-specific play activities during the *early* stage of their adolescence (13 to 15 years of age), we conducted a post hoc planned contrast. This comparison revealed that the high-creative group engaged in more hours per year in soccer play activity during early adolescence when compared with the low-creative group (M = 202.6 ± 93.0 h · year $^{-1}$ vs. M = 93.1 ± 57.6 h · year $^{-1}$, $p < .01$, $d = 1.42$) (see Figure 1).

Other sports activity. The descriptive and inferential statistics for engagement in other sports between groups are presented in Table 2. The number of other sports engaged in and the hours accumulated in those sports did not differentiate groups for either of the two developmental stages examined (i.e., 6-12 and 13-18 years of age). Participants in the high-creative group engaged in an average of 3 other sports in the childhood stage and 2 other sports during adolescence, whereas the low-creative engaged in 2 other sports throughout their development. The most popular other sports in which players participated across the two groups were athletics (n = 10 players), swimming (n = 8 players), basketball (n = 7 players), and rugby (n = 5 players).

Insert Table 2 about here

Discussion

In line with our hypothesis, the results showed that the players classified as high-creative from the test had accumulated more total hours in soccer-specific activity throughout their development compared to those classified as low-creative. This

difference is primarily the result of the main finding that the high-creative group spent significantly more average hours per year in soccer play activity during childhood and early adolescence (i.e., 6-15 years of age) when compared with their low-creative counterparts. The high-creative group were engaging in around 345 h · year $^{-1}$ (corresponding to 7 h · week $^{-1}$) of soccer-specific play activity during this development period compared to just 192 h · year $^{-1}$ (around 4 h · week $^{-1}$) recorded for the low-creative players. There were no other between-group differences in milestones, soccer-specific activity, or other sports.

Our findings support those reported by Memmert et al. (2010) who showed that free, unstructured sport-specific play activity may be an important contributor to the development of superior creativity in team ball sports such as soccer. The high-creative group in our study had accumulated around 2760 h of this activity up to the age of 14, which is greater than the 1341 h reported by Memmert et al. (2010) for highly creative athletes from the sports of soccer, basketball, handball, and field hockey. However, this comparison is challenging to make since Memmert and colleagues either merely reported the average hours accumulated in sport-specific play in the main sport across all the four sports combined or for each sport when the data for the two creative groups was merged.

Multiple and greater benefits are thought to be gained by increased engagement in sport-specific, play activity when compared to the more structured deliberate practice activities. Such playful, non-linear environments provide children the freedom to problem-solve and greater opportunities to experiment with new movements and various technical and tactical skills within their sport (Memmert et al., 2010; Turnnidge, Allan, & Côté, 2019). This offers youngsters the chance to improvise, innovate and be adaptable, re-creating those conditions that are crucial at the top level in numerous

sports (Santos, Memmert, Sampaio, & Leite, 2016; Williams, Ford, Eccles, & Ward, 2011). As researchers have found, children's sport practice under the supervision of a coach (i.e., team practice in soccer academies) is often overly prescriptive, with coaches providing constant instruction relating what players should do and when (Ford, Yates, & Williams, 2010), potentially inhibiting the development of creativity and the ability to be adaptive to changing match situations. Additionally, some empirical support exists (e.g., Henry et al., 2018; Martin & Cox, 2016; Richard, Abdulla, & Runco, 2017) to indicate that too much investment in 'specialized' deliberate practice, with a more rigid skill-based approach, can lead athletes to rely on established knowledge and preventing them from exploring new ideas/solutions that are crucial for the development of specific creative performance. Hence, considerable engagement in free play activity in the primary sport during the initial periods of youth development may be a necessary antecedent to the acquisition and attainment of domain-specific expert creativity. There is evidence to suggest that those players who can retain a sense of spontaneity, 'mischievousness', and creativity at the top level of their sport are more likely to shape a game than those who are ruthlessly well-drilled (Memmert & König, 2019). With respect to practical implications for sport organizations, clubs, and coaches, we emphasize the growing need for implementing well-founded youth programs and training activities that encompass key elements of deliberate play such as fun, freedom to experiment with new ideas, and greater opportunities to be adaptive to the ever-changing game situations so as to facilitate athletes' development of superior levels of sporting creativity. Perhaps this proposal has never been more relevant in the modern times for sports like soccer where we have seen the extinction of the so called 'street soccer' in the developed world and children joining youth soccer academies and clubs at increasingly younger ages (Machado et al., 2019).

The two groups were not statistically differentiated in other sport engagement during the two development periods. The high creative group participated in a mean number of three other sports during childhood (i.e., 6-12 years of age) when compared to two other sports for their low-creative counterparts (this difference achieved a medium effect size). The number of hours spent in other sports during childhood equated to around 3 h · week $^{-1}$ over a 50-week year for the high- and low-creative groups. In comparison, the high-creative group participated in twice as many hours in weekly self-led soccer play activity (around 7 h · week $^{-1}$ over a 50-week year). The lack of between-group differences in other sports contradicts the early diversification model (i.e., participants sample a number of different sports during childhood) proposed in the Developmental Model of Sport Participation (Côté et al., 2007), albeit both groups were engaging in meaningful amounts of other sports during their development. The higher amount of soccer activity compared to other sports during childhood in the participation history profiles of the players supports the early engagement hypothesis proposed by Ford, Ward, Hodges, and Williams (2009). According to this hypothesis, players spend a meaningful amount of time in their primary sport during childhood, particularly in soccer through free play.

A potential limitation with the method employed in this study to elicit information relating to the developmental activities undertaken by players is that the operational definitions of deliberate practice and deliberate play may be seen as relatively too broad and simplistic in nature (De Sá Fardilha & Allen, 2020; Henry et al., 2018). For example, the diversity and quality of training sessions/programs (e.g., coaches' ability to design effective practice activities) that players may have encountered during their soccer clubs' youth developmental years could have also played a valuable part in the acquisition of creativity. In future, researchers should

attempt to explore the nature and acquisition of the underlying perceptual-cognitive processes associated to different types of deliberate practice and play activities to better understand how these activities may facilitate and contribute to the development of sporting creativity.

In summary, we have attempted to identify the activities that contribute to the development of creative decision making in soccer by examining differences in participation history profiles of skilled soccer players who were objectively classified as either high- or low-creative players based on their performance on a soccer-specific creativity test. We have reported that high-creative players spent more hours in free, unstructured soccer-specific play activity during childhood and early adolescence (i.e., 6-15 years of age) when compared to low-creative players, suggesting that this type of engagement is positively associated with and essential for the development of superior levels of creativity in this sport. In future, there is a need for longitudinal and intervention-based research to help establish processes that can enhance or accelerate the development of creative decision-making ability.

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612 Table 1. The statistical and descriptive analyses for soccer milestones (in years)

Variable and comparison	*t*	Cohen's *d*	Mean ± *s*
Chronological age[a]	0.61	0.25	High creative = 21.1 ± 2.3
			Low creative = 20.6 ± 1.7
Start ages			
In soccer[a]	0.99	0.40	High creative = 5.4 ± 0.9
			Low creative = 5.9 ± 1.5
In supervised training	0.93	0.34	High creative = 7.6 ± 2.5
			Low creative = 8.6 ± 2.9
In soccer league[a]	0.83	0.30	High creative = 8.6 ± 2.3
			Low creative = 9.5 ± 3.0
In elite training program	0.06	0.04	High creative (*n* = 11) = 12.2 ± 2.6
			Low creative (*n* = 12) = 12.3 ± 2.7
At semi-professional level	0.77	0.67	High creative (*n* = 10) = 17.7 ± 2.3
			Low creative (*n* = 10) = 17.1 ± 0.9
At professional level	0.22	0.12	High creative (*n* = 5) = 18.0 ± 1.7
			Low creative (*n* = 4) = 17.8 ± 1.7

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615 Table 2. The statistical and descriptive analyses for engagement in other sports

Variable and comparison	*t*	Cohen's *d*	Mean ± *s*
Number of other sports			
6-12 years	1.62	0.64	High creative = 2.6 ± 1.2 sports
			Low creative = 1.8 ± 1.3 sports
13-18 years	0.39	-0.11	High creative = 1.5 ± 1.0 sports
			Low creative = 1.6 ± 0.8 sports
Hours accumulated			
6-12 years	0.65	0.26	High creative = 1103.8 ± 738.1 h
			Low creative = 863.9 ± 1054.9 h
13-18 years	-1.32	-0.54	High creative = 425.3 ± 446.9 h
			Low creative = 794.4 ± 859.5 h

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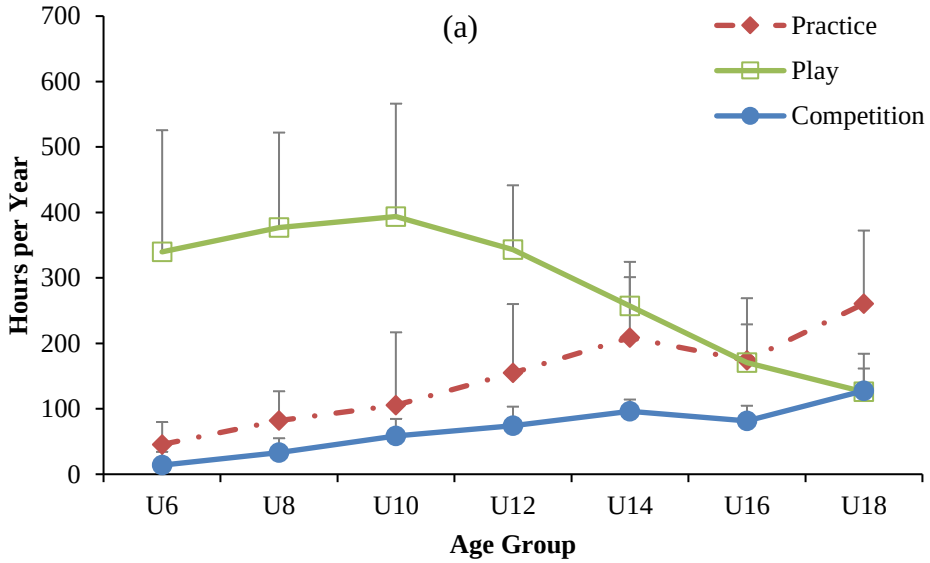

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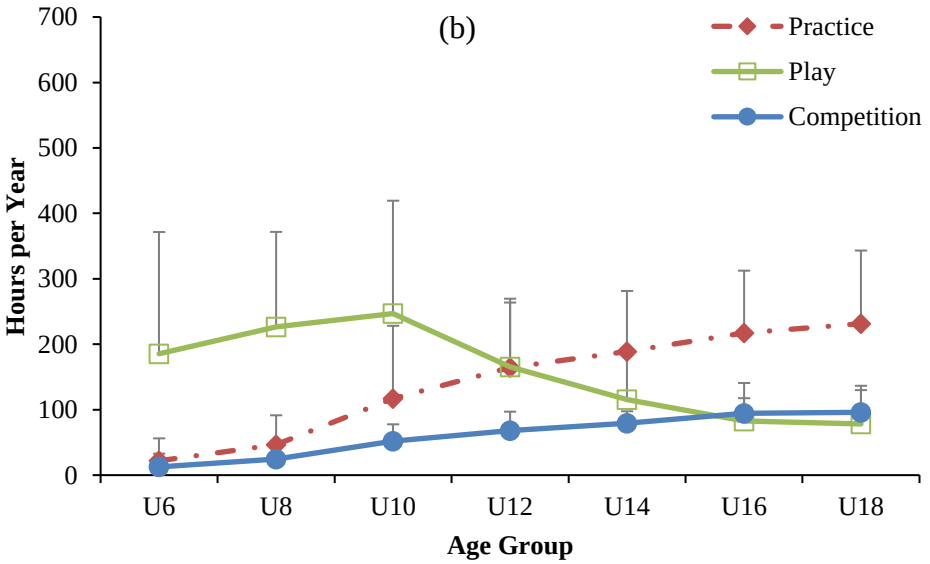

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634 Figure 1. Mean (± *s*) hours per year spent in each of three soccer activities (practice, play,

635 competition) as a function of age group for (a) high-creative and (b) low-creative players.