

**How football team composition constrains emergent individual and collective tactical behaviours: Effects of player roles in creating different landscapes for shared affordances in small-sided and conditioned games**

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1 **How Football team composition constrains emergent individual and collective tactical**  
2 **behaviours: Effects of player roles in creating different landscapes for shared**  
3 **affordances in small-sided and conditioned games**  
4

5 **Abstract**

6 The aim of the present study was to examine how team composition of players with different  
7 roles constrains individual and collective tactical behaviours, and ball possession  
8 effectiveness, during competitive 3 vs 3 small-sided and conditioned games (SSCGs) in  
9 youth soccer players. Fifteen male players (under 15 yrs, mean age 13.2 +- 1.03 years, mean  
10 years of practice: 4.2 +- 1.10 years) from the same club participated in this study. For  
11 analysis purposes, on advice from the coaching staff, participants were categorised according  
12 to their main team performance role, resulting in sub-samples of 5 defenders (centre-backs=2  
13 and full- backs=3), 7 midfielders (central midfielders=3 and wide midfielders=4) and 3  
14 attackers (forwards). In order to assess participant tactical behaviours, a notational analysis  
15 system was created with four categories: i) team behaviours, ii) individual players' offensive  
16 actions, iii) individual players' defensive actions, and iv), ball possession effectiveness.  
17 Analysis of players' offensive actions revealed that the team composed only of midfielders  
18 revealed a higher frequency of diagonal and vertical passes in relation to the attackers' team.  
19 In offensive individual actions, the attackers' team revealed more dribbles in relation to the  
20 teams of defenders and midfielders. Analysis of ball possession effectiveness revealed that  
21 the team of defenders achieved higher values of shots on goal compared to the team of  
22 midfielders. These findings exemplified how playing role constrains the emergence of  
23 different collective behaviours and individual actions in 3 vs 3 SSCGs.

24

25 **Key words:** Playing roles, Decision-making, Game-based situations, Ecological dynamics,  
26 Association Football

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## 32 **Introduction**

33 In line with the ecological dynamics perspective, tactical behaviours of players and teams  
34 result from information exchanges that emerge among players, based on their action  
35 capabilities (physical, technical, and tactical) (Folgado et al., 2018; Travassos et al., 2012).  
36 Players and teams constantly interact to form synergies and create information, making  
37 decisions and organizing actions, according to collective *possibilities for action* of the team,  
38 known as affordances (Araújo et al., 2017; Gibson, 1979).

39 Ecological dynamics views competitive performance behaviours in sports teams as emerging  
40 from the sharing of available affordances (Silva et al., 2013). According to Gibson (1979),  
41 affordances are opportunities or possibilities for action that exist in a performance  
42 environment. In football, players are able to perceive the availability of space and time  
43 provided by the movements of teammates and opponents, which offers information about the  
44 possibilities for action (affordances) such as an open space for dribbling, a passing or a  
45 shooting gap. Affordances are not only dependent on changes in the contexts of play, but also  
46 dependent on individual players' capabilities and their intentions during performance (e.g., to  
47 attack urgently or play conservatively) (Silva et al., 2013). Players' adaptations to changes in  
48 competitive performance environments are regulated by the environmental information  
49 surrounding each individual, that they perceive in order to interact with other individuals  
50 (Gonçalves et al., 2017). For each individual, and collective sub-units of players (e.g.,  
51 attackers, defenders, midfielders), previous research has revealed that affordances are  
52 available in the environment, but their utilisation is dependent on each individual's intentions,  
53 motivations, values and capabilities (Araújo et al., 2017). Not all individuals perceive and  
54 utilise the same affordances in a performance environment, due to differences in their situated  
55 intentions, skill levels and attunement to the information available to support the actions  
56 required by their roles (Jordet et al., 2020; Laakso et al., 2017).

57 In the sport of football, the number of players involved, and the use of structured patterns of  
58 play, have promoted a greater specialization of players' roles. Each player's role (generally  
59 categorised as defenders, midfielders and attackers) has specific technical, tactical and  
60 physical playing demands, which may need to be adapted due to varying performance  
61 constraints (Davids et al., 2005). For example, recent research has revealed some differences  
62 in the perceptual scanning frequency of players of different roles, with the central midfielders  
63 revealing the highest mean frequency (perhaps due to density of player numbers in that field

64 location) and attackers the lowest mean frequency of emergent scanning behaviours (perhaps  
65 due to proximity to goal affording shots) (Jordet et al., 2020).

66 The use of available affordances during performance is sustained by variations in space-time  
67 relations defined by co-positioning of teammates and opponents, as well as co-variations in  
68 their displacement trajectories and their movement velocities with respect to field markings  
69 and dimensions (Silva et al., 2013; Vilar et al., 2012). Players perceptually attune to  
70 information specifying affordances for action through, for example, visual exploratory actions,  
71 which entail eye, head and body movements, supporting the pick-up of visual information  
72 (McGuckian et al., 2018). So, the capability of individuals to perceive and act upon  
73 affordances in a performance environment, should be continually influenced by each player's  
74 role, continually shaping their ability to pick up and use information from the competitive  
75 environment and functionally adjust their individual tactical behaviours (Passos et al., 2013).

76 These ideas suggest that, in performance, players in different playing roles should use  
77 different sources of information to successfully regulate their competitive actions (Jordet et  
78 al., 2020). In fact, each player assumes a specific role on field according to the tactical system  
79 and principles defined by the coach to defend or exploit space and create/prevent scoring  
80 opportunities (Duarte et al., 2012; Gonçalves et al., 2017). The exploitation of affordances by  
81 each player is influenced by the team's general patterns of play, but particularly by their  
82 surrounding information. That is, when a player is in a defensive area of the pitch (mostly  
83 populated by defenders), the majority of game-relevant information for that player is likely to  
84 be in front of them (i.e. in an attacking direction). In contrast, a player who is situated in a  
85 midfield area of the pitch (midfielders) is likely to be completely surrounded by game-  
86 relevant environmental information (Aksum et al., 2020). Accordingly, it is likely that each  
87 player's main role on the pitch influences, not only the perceptual scanning frequency (Jordet  
88 et al., 2020), but also the nature of the exploratory actions that are used to perceive the  
89 surrounding environment (McGuckian et al., 2018). These important performance constraints  
90 on behaviour led us to expect to observe different individual and collective tactical  
91 behaviours for players, not only inside of the game dynamics, but also to accomplish the  
92 same performance goals.

93 Indeed, previous research has revealed that players with different roles (such as mainly  
94 attacking or defending) display different individual tactical behaviours to manage the spatial-  
95 temporal relations with teammates and opponents in 1 vs 1 (Laakso et al., 2017) and 2 vs 1

96 sub-phases of football (Laakso et al., 2019). Also, in the context of the manipulation of small-  
97 sided and conditioned games (SSCGs), Baptista et al. (2020) revealed that variations in  
98 tactical systems of play, according to the players' roles used in each team (i.e. defenders,  
99 midfielders or attackers), promoted changes in interpersonal dynamics during SSCGs.

100 Despite these findings, in the practice of SSCGs, particularly in teams of youth players (from  
101 3x3 to 5x5), coaches usually mix players up into small teams without at all considering the  
102 impact of mixing players with different playing roles (i.e. defenders, midfielders or attackers)  
103 on the emergent tactical behaviours of players and teams during practice. There is a need to  
104 understand how teams constituted by players of different roles influences the tactical  
105 exploration of possibilities for action during performance as well as their effectiveness  
106 percentages. These findings could inform sport practitioners on the need for players to be  
107 exposed to more specialised (i.e., role-based) and more general (varying roles) affordances  
108 from the design of small-sided and conditioned games. Thus, the aim of the present study was  
109 to examine how team composition of players with different roles constrains emergence of  
110 individual and collective tactical behaviours, as well as effectiveness, during competitive  
111 SSCGs in youth soccer players. Due to the influence of their roles on performance dynamics,  
112 we expected to observe changes in emergence of collective and individual offensive and  
113 defensive tactical behaviours, according to the nature of each team's role composition  
114 (whether attackers, defenders, or midfielders).

115

## 116 **Methods**

### 117 *Participants*

118 Fifteen male players (under 15 yrs, mean age  $13.2 \pm 1.03$  years, mean years of practice  $4.2 \pm$   
119  $1.10$  years), from the same club in a national level Finnish team, participated in this study  
120 (2016/2017 season). For purposes of analysis, participants were divided into three groups  
121 according to their main playing role on field (defenders, midfielders and attackers). On  
122 advice of the coaching staff, participants were categorised into their main team performance  
123 role, resulting in sub-samples of 5 defenders (centre-backs=2 and full-backs=3), 7  
124 midfielders (central midfielders=3 and wide midfielders=4) and 3 attackers (forwards). All  
125 players were right-foot dominant and were part of the U15s team of the club. All participants  
126 undertook five training sessions per week (90 minutes per session) and played one official  
127 GK+11 v 11+GK competitive match at the weekend. The club, all parents and participants

128 provided prior informed consent for participation in the study. The study was approved by the  
129 Ethics local Committee according to the Declaration of Helsinki.

130

### 131 *Task and procedure*

132 All small-sided games were played in one training session during the summer break of the  
133 competitive season (July) on an artificial grass pitch, with an ambient temperature of about  
134 18-20 °C. In the summer break, the team had no official competitive matches, only daily  
135 training sessions. Before data collection, all participants engaged in a thorough warm-up  
136 routine (15 mins of jogging, 10 mins of technical actions with ball and 10 mins of stretching).  
137 Each team played against each other (i.e. defenders vs midfielders, defenders vs attackers,  
138 attackers vs midfielders) in a playing area of 30 x 25 m (Owen et al. 2004). Three games  
139 were played in each training session in a random order over three different days, resulting in  
140 a total number of 9 games. A regulation ball size 5 was used in all games. The small-sided  
141 game constraints included a regular size goal (2.44 m x 7.32 m) protected by a goalkeeper for  
142 both sides (Gk+3 vs 3+Gk). Each game was timed for 5 minutes. All the players/teams had at  
143 least 10mins of rest between trials and played a maximum of two games each day, in order to  
144 avoid fatigue. The goalkeepers stayed guarding the same goals, but the team's direction of  
145 play was systematically changed. The Gk+3 vs 3+Gk format was used to better capture the  
146 players' adaptations to the context of play according to players' specific roles.

147 The Gk+3 vs 3+Gk sub-phase was played with official football rules, with some exceptions  
148 /modifications: i) the offside rule did not apply; ii) when the ball left the field or a goal was  
149 scored, the game was always restarted by the goalkeeper of team with ball possession, with  
150 both teams located in their own pitch half; and iii), as the goalkeeper opened the game and  
151 the first player touched the ball, both teams played without restrictions.

152 Before the small-sided games, all participants were informed about the rules and the goals of  
153 the task/exercise and encouraged to compete to win games. The goalkeepers were also  
154 instructed to perform as if in a competitive game. No coach feedback or encouragement was  
155 allowed during the games to avoid the potential biasing effects of feedback on individual  
156 participant performance. The aim of the participants in these games was to score and prevent  
157 goals and try to win each game.

158 Participant movements were captured by using a digital video camera (Sony HRX-MC50E)  
159 placed 7 m above the ground, forming an angle of approximately 45° with the longitudinal  
160 axis of the performance area to capture participant movements during the whole task (for  
161 more details see Fernandes et al., 2010). All the video recordings captured the displacement  
162 trajectories of all participants without moving the camera.

163

#### 164 *Instruments*

165 In order to assess the tactical behaviours of teams and players, and based on variables  
166 recorded in previous studies (see Andrzejewski et al., 2014; Hughes & Probert, 2006) a  
167 notational analysis system was created with four categories: i) team behaviours, ii) players'  
168 offensive individual actions, iii) players' defensive individual actions, and iv), ball possession  
169 effectiveness (see Table 1 for independent variables and their description). All data were  
170 collected by the first author. As a preliminary step, all the variables coded were discussed and  
171 described by the authors in line with recommendations in previous research (see  
172 Andrzejewski et al., 2014; Hughes & Probert, 2006). To check the reliability of  
173 measurements, the same sample of matches were coded after an interval of two weeks. Intra-  
174 observer reliability was calculated using the Cohen K index (Hughes & Franks, 2008). We  
175 found values of  $K = 0.913$  ensuring an adequate reliability of data.

176

**\*\*\*Insert Table 1 near here\*\*\***

#### 177 *Statistical analysis*

178 A Shapiro-Wilks test was used to assess the normality of data distribution. Due to the existence  
179 of non-normal distribution of data, differences between performance variables were assessed  
180 using a non-parametric test. A Kruskal-Wallis test was conducted to evaluate differences  
181 between the values observed for teams composed of defenders, midfielders, and attackers.  
182 Observed significant effects were followed up using the Bonferroni post hoc test. All statistical  
183 analyses were performed using the Statistical Package for Social Sciences software V24.0  
184 (IBM SPSS Statistics for Windows, Armonk, NY: IBM Corp.), and statistical significance  
185 levels were set at  $p < .05$ . Additionally, *Cohen's d* was calculated to obtain the magnitude of  
186 differences through an effect size calculator for non-parametric tests  
187 ([www.psychometrica.de/effect\\_size.html](http://www.psychometrica.de/effect_size.html)), classifying values as very low (0–0.2), low (0.2–  
188 0.6), moderate (0.6–1.2), high (1.2–2.0) or very high (>2.0) (Hopkins et al., 2009).

## 190 **Results**

191 Regarding team tactical behaviours, no statistically significant differences were observed for  
192 the variables: ball possession and number of players involved in the attack, in teams  
193 composed of players with different roles ( $p > 0.05$ ) (see Table 2).

194 Analysis of participants' offensive individual actions did not reveal significant differences  
195 between teams with players of different roles for the following variables: number of  
196 completed successful passes, lateral and backward passes and penetrative passes ( $p > 0.05$ ).  
197 However, statistically significant between-team differences in performance variables were  
198 observed for the number of diagonal and vertical passes and dribbles completed ( $p < 0.05$ )  
199 (see Table 2). For diagonal and vertical passes, post hoc analysis revealed that the team of  
200 midfielders revealed the higher number of diagonal and vertical passes ( $1.22 \pm 0.67$ ) during  
201 performance, with significant differences in relation to values displayed by team of attackers  
202 ( $0.73 \pm 0.59$ ,  $p < 0.05$ ,  $d = 0.71$ , moderate effect). No other differences were observed for  
203 diagonal and vertical passes between the teams ( $p > 0.05$ ). Regarding the number of dribbles  
204 completed, post hoc analysis revealed that the team of attackers displayed the highest number  
205 of successfully completed dribbles ( $0.53 \pm 0.78$ ), with significant differences in relation to  
206 values displayed by teams of defenders ( $0.18 \pm 0.39$ ,  $p < 0.05$ ,  $d = 0.65$ , moderate effect) and  
207 midfielders ( $0.16 \pm 0.37$ ,  $p < 0.05$ ,  $d = 0.66$ , moderate effect). No differences in that  
208 performance variable were observed between the teams of defenders and midfielders ( $p >$   
209  $0.05$ ).

210 **\*\*\*Insert Table 2 near here\*\*\***

211 Analysis of participants' defensive individual actions did not reveal significant differences  
212 between teams for the variables of ball recoveries and balls intercepted ( $p > 0.05$ ) (see Table  
213 2). However, even without a statistically significant outcome, a tendency for the team of  
214 defenders to intercept a greater number of passes was recorded.

215 Finally, analysis of ball possession effectiveness, revealed significant differences for the  
216 variables lost possession and shots at goal between teams' roles ( $p > 0.05$ ) (see Table 2). For  
217 lost possession, post hoc analysis revealed that the team of attackers displayed the highest  
218 number of lost balls ( $0.65 \pm 0.74$ ), with significant differences in relation to values displayed  
219 by team of defenders ( $0.28 \pm 0.45$ ,  $p < 0.01$ ,  $d = 0.60$ , moderate effect). Significant differences



220 were also displayed between defenders ( $0.28\pm0.45$ ) and midfielders ( $0.57\pm0.64$ ,  $p < 0.03$ ,  $d =$   
221  $0.53$ , low effect) for this variable, although no differences were observed between the teams  
222 of midfielders and attackers ( $p > 0.05$ ). Regarding the variable Shots at goal, post hoc  
223 analysis revealed that the team of defenders displayed the highest number of shots completed  
224 ( $1.28\pm0.84$ ), with significant differences in relation to values displayed by the teams of  
225 midfielders ( $0.63\pm0.78$ ,  $p < 0.01$ ,  $d = -0.80$ , moderate effect). No differences in this  
226 performance variable were observed between the teams of defenders and midfielders and  
227 midfielders and attackers ( $p > 0.05$ ).

228

## 229 **Discussion**

230 The aim of this study was to examine how SSCG teams, composed of players with team  
231 differing roles, influenced the emergence of individual and collective tactical behaviours, as  
232 well as the ball possession effectiveness in youth soccer players. In line with our  
233 expectations, results revealed variations in individual offensive and defensive tactical  
234 behaviours that emerged from teams of players with different roles in the U15 yrs squad, as  
235 well as in the ball possession effectiveness of the composed teams. No differences were  
236 observed for team behaviors in analyses of time spent in ball possession and number of  
237 players involved in each attack. These results reinforced the co-adaptive behaviours of  
238 players of different roles, through the creation of particular game dynamics, and according to  
239 their role dispositions and capacities.

240 These findings support the idea that the current methods of player development in practice,  
241 performance and learning environments promote the development of role-specific skills and  
242 expertise, founded on motivations, values and capabilities of players. In particular current  
243 development methods shape the use of different individual affordances for players in similar  
244 game environments (Silva et al., 2013). Thus, it can be assumed that playing roles in  
245 association football may not only be characterized by different anthropometrical or  
246 physiological differences of individuals (Di Salvo et al., 2007; Marques et al., 2016), but also  
247 by different technical-tactical capabilities required by specific roles in which players are  
248 specialising (Laakso et al., 2019). An ecological dynamics rationale for the current findings  
249 suggest that players' main team roles seem to impact on their perception-action systems (i.e.  
250 the way they use information to regulate their actions), changing their capabilities for action  
251 during these learning experiences (intrinsic effectivities or readiness for action) (Araújo et al.,

252 2006; Davids et al., 2005). Our findings show that players' roles are a key constraint on the  
253 nature of the individual tactical actions that they learn to perform. Our evidence, showing role  
254 effects on learned behaviours, is well aligned with previous data, for example, evidencing  
255 role effects on players' spatial-temporal relations to perform (Laakso et al., 2019) or on the  
256 exploratory movements used to perceive the specifying properties of the surrounding  
257 environment (Jordet et al., 2020; McGuckian et al., 2018) that sustain affordances.

258 The lack of differences of role effects on team behaviors could be influenced by the  
259 numerical relations and the format of play used. Further research should be developed to  
260 understand the impact of individual changes at team level, by changing the number of players  
261 involved in practice games. In this particular format, it mean that variations in players' roles  
262 may not promote adaptive behaviours at the team level, but only in the process of synergy  
263 formation at individual (i.e. organization of actions) and sub-group levels of performance (i.e.  
264 coordinated activities between players) (Duarte et al., 2012). These findings emphasize that  
265 exploitation of available affordances in SSCGs, as key learning environments, by players is  
266 particularly sustained by increased capacity to attune to the nature of surrounding  
267 information. Further research is required to understand the impact of manipulating players'  
268 roles on emergent collective behaviors of SSCG teams in practice environments, using  
269 different metrics of analysis related to spatial-temporal relationships that emerge between  
270 players during performance.

271 Coaches' favoured designs and tendencies to maintain players in specialized roles during  
272 practice may impact their capacity to adapt and use available affordances in different  
273 locations of the field. This idea was supported by data from analyses of players' offensive  
274 individual actions, revealing that the team composed only of midfielders revealed a higher  
275 frequency of completed diagonal and vertical passes, compared to the team of attackers. Also,  
276 in performing individual offensive actions, the attackers' team displayed more dribbles in  
277 relation to teams of defenders and midfielders. Interestingly, analysis of ball possession  
278 effectiveness revealed that the team of defenders achieved a greater number of shots on goal,  
279 compared to the team of midfielders.

280

### 281 *Defenders' team role*

282 The role of defenders in 11-a side versions of football, when in possession of the ball is to  
283 initiate attacks by creating space to pass the ball to the midfield players and ensure the

284 creation of space for supportive passes to maintain ball possession under pressure (Baptista et  
285 al., 2018). The lower number of dribbles completed by the team of defenders, which was  
286 statistically different to the number of dribbles completed by the attackers, highlighted that  
287 field location constrains the information and actions that players tend to explore to  
288 successfully progress up field. In fact, previous research (Headrick et al., 2011) has revealed  
289 that the proximity to the goal constrains the spatial-temporal relations of players involved in  
290 1v1 contexts. Also, evidence suggests that defenders tend to explore the affordances to  
291 progress upfield, based on the notion of risks of a change in ball possession in spaces nearer  
292 the goal (Travassos et al., 2014). Thus, supporting the notion of exploration and utilisation of  
293 available affordances during competitive performance, these findings signify how players act  
294 on affordances available in spatio-temporal properties of a performance environment,  
295 available for themselves according to their own roles and spaces of play (Baptista et al.,  
296 2020).

297 Consequently, in line with previous research, the team of defenders in this study, in  
298 comparison to teams of midfielders and attackers, revealed greater capability to control and  
299 manage available space relative to the opposition (Baptista et al., 2020). Since the main role  
300 of defenders during performance, is to protect their own goal, prevent use of free space in  
301 critical scoring areas by attackers, and recover ball possession, our findings suggest that  
302 players in defensive roles tend to develop greater awareness of affordances of space in front,  
303 between and behind themselves, than teammates with other roles.

304 Against our expectations, analysis of ball possession effectiveness revealed that teams of  
305 defenders also displayed a lower tendency to lose ball possession, which significantly  
306 differed to the team of attackers. The team of defenders also displayed a greater number of  
307 shots at goal in relation to the team of midfielders, an unexpected finding given their main  
308 team role. However, the explanation for this unexpected finding could be a result of the  
309 players being able to maintain team balance when involved counter-attacks, from defensive  
310 positions (Baptista et al., 2020). That is, even without statistical differences to performance  
311 behaviours of the teams of midfielders and attackers, the defenders revealed a tendency to  
312 recover the ball by interceptions, facilitating a great number of counterattacks and shots at  
313 goal. According to our previous research, teams of defenders tend to maintain higher values  
314 of interpersonal distances with opponents and play with lower levels of risk, than teams of  
315 midfielders and attackers (Laakso et al., 2019). Thus, the higher number of completed shots  
316 in 3v3 SSCGs may be a consequence of being able to perceive affordances for passes in

317 opponents and, therefore, intercept more passes, as well as losing possession less often,  
318 allowing them to progress forward for shots at goal. However, more information is required  
319 to sustain this assumption and further research is required to analyse the origin of the ball re-  
320 possessions that ended in shots at goal by defenders, midfielders, and attackers. Also, there is  
321 a need for further research with e SSCGs involving different numbers of players to  
322 understand whether the effectiveness obtained by the team of defending players in 3v3  
323 transfers to other task constraints (e.g., 5v5 or 7v7).

324

### 325 *Midfielders' team role*

326 The midfielders' main role is to operate between attackers and defenders, creating variability  
327 in the exploration of possibilities for action of attackers to destabilize the defending team and  
328 score goals. It means that they constantly need to explore the relevant environmental  
329 information during performance that support their positioning and actions to allow the team  
330 to progress up field (Clemente et al., 2015). In the analysis of individual attacking actions,  
331 team of midfielders tended to perform a greater number of diagonal and vertical passes,  
332 compared to the team of attackers. Such results are aligned with previous findings on passing  
333 frequency of midfielders. It has been observed that midfielders preferentially explore  
334 affordances for passing opportunities to progress up field, through the defensive lines,  
335 seeking to play penetrative passes to attackers in space (Liu et al., 2016; Passos et al., 2020).  
336 In fact, midfielder players are usually the players with higher centrality of play (i.e., the  
337 players that receive and distribute more passes to other players) inside of the network of  
338 relations of a team, assuming the main responsibility to promote the flow of passes between  
339 different team sectors (Gonçalves et al., 2017).

340 In line with our previous findings, midfielders revealed, in ball possession effectiveness, a  
341 lower number of shots at goal, compared to teams of defenders. Due to their greater  
342 propensity to perform more passes and to explore opportunities for penetrative passes in  
343 progressing up field, the performance analysis of the midfielder teams highlighted how  
344 previous experience in their specific roles influenced participants to explore the affordances  
345 of the 3vs3 performance landscape (Clemente et al., 2015; Konefał et al., 2019).

346

### 347 *Attackers' team role*

348 The attackers' main role is to perform in areas of the field outnumbered by defenders, with  
349 restrictions on space and time to receive the ball, dribble and create opportunities to assist or  
350 to shot at goal. Attackers should have good skills with the ball to win 1 vs 1 contexts with  
351 immediate opponents and to dribble into critical scoring spaces. That is, they usually reveal  
352 versatile and creative technical actions that allow them to be more unpredictable in de-  
353 stabilising defensive formations and to create space to shoot at goal (Coutinho et al., 2018).  
354 However, previous research has revealed that attackers display the lowest rate of perceptual  
355 scanning frequency for information during play (Jordet et al., 2020). Perhaps, because  
356 attackers have restrictions of space and time to receive the ball in dangerous areas of the field  
357 and to perform shots at goal, they tend to focus their attention on nearby surrounding  
358 information (i.e. goal location) in order to gain advantages in relation to immediate opponents  
359 (Clemente et al., 2015). In line with this role tendency, attackers displayed a higher number  
360 of dribbles in relation the teams of defenders and midfielders and, in general, a lower number  
361 of completed diagonal and vertical passes in comparison to the midfielders. Such  
362 observations are in line with data from previous studies that revealed that the lower  
363 perceptual scanning frequency of attackers could be associated with the fewer number of  
364 completed passes and higher number of completed dribbling actions (McGuckian et al.,  
365 2018). This finding is also in line with outcomes of previous studies where attackers  
366 completed fewer forward passes, compared players in other roles, perhaps explained by  
367 attackers typically having their back to goal during build-up play (Dellal et al., 2011).

368 Analysis of ball possession effectiveness revealed differing results compared to previous  
369 studies (Gai et al., 2019; Yi et al., 2019), where attackers performed more shots and scored  
370 more goals compared to players in other roles. However, such studies have reported  
371 differences in tactical performance behaviours emerging from performance in different  
372 playing roles, but within a single SSCG team composed of a mix of defenders, midfielders  
373 and attackers. Also, as previously stated, the use of the 3vs3 format cannot sample the  
374 perceptual-action task constraints that attackers face in 11vs11 competitive conditions. It is  
375 clear that players will use different perceptual information, available affordances and action  
376 requirements to constrain performance under different task constraints, for example, when  
377 shooting at goal. The attacking team also tended to lose the ball more often, compared to the  
378 team of defenders. One explanation for a greater frequency of lost ball possession is that the  
379 team of attackers were the group most focused on taking risks to go past opponents to win 1  
380 vs 1 situations.

381

## 382 **Practical implications**

383 The obtained results allow coaches to understand how manipulating the players' role in  
384 SSCGs can change the affordance landscape and the training session dynamics. The findings  
385 suggest also that coaches should manipulate SSCGs situations for players to experience a  
386 variety of playing roles to increase opportunities for the players to explore synergy formation  
387 with teammates. These manipulations in practice design could help players to develop new  
388 effectivities (capabilities) to explore competitive performance environments from different  
389 perspectives, rather than just from the roles developed in an early specialization process.

390 Results suggested that coaches could design SSCGs with a team of defenders against  
391 midfielders or attackers to promote specific skills and collective behaviours. For example,  
392 after losing ball possession, the players could learn to perform individually and collectively to  
393 regain spatial-temporal equilibrium relative to ball location, while exploring the possibility to  
394 recover the ball. Also, an SSCG pitting a team of midfielders against a team of defenders or  
395 attackers could be used to promote spatial-temporal balance in defence, providing  
396 affordances for making or preventing diagonal and vertical passes and for recovering ball  
397 possession. Finally, an SSCG with a team of attackers against of a team of defenders or  
398 midfielders, could be designed to improve players' defensive capability to face the dribbles of  
399 attackers and also practice recovering ball possession.

400 In summary, players' main team roles seem to have an impact on their current capabilities for  
401 action that can emerge during performance. In line with that finding, our data imply that  
402 coaches should constantly promote changes in the field dimensions and other properties of  
403 SSCGs, allowing players to explore different performance sub-phases or different playing  
404 roles, promoting opportunities for exploration of different possibilities for action, in different  
405 affordance landscapes.

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## 407 **Conclusions**

408 Our findings suggested how the main playing role of a performer may constrain and promote  
409 different emergent collective behaviours and individual actions in 3 vs 3 SSCGs. Due to  
410 differences in performance context, players with different playing roles seem to exploit  
411 affordances and perform differently in competitive conditions (Aksum et al., 2020). Some

412 previous studies also observed similar results of effects of players roles in 1 vs 1 contexts  
413 (Headrick et al., 2011; Laakso et al., 2017) and 2 vs 1 (Laakso et al., 2019) sub-phases in  
414 football. Despite these obtained results, some limitations should be acknowledged. In this  
415 study, only U15 yrs players from one team were considered for analysis. Nevertheless, the  
416 findings suggest the need for further research for investigations with a larger sample and  
417 using different SSCGs formats (i.e. 4 v 4, 5 v 5, 6 v 6 or 7 v 7) in order to discover whether  
418 similar results may be observed with players of different ages and level of practice. In fact,  
419 the effectiveness of players, the constitution of teams or even the structure of play used seems  
420 influence the exploitation of possibilities for action and should be considered as a part of the  
421 formula of the design of training sessions to improve the learning and the performance  
422 development of players.

## 423 **References**

- 424 Aksum, K. M., Magnaguagno, L., Bjørndal, C. T., & Jordet, G. (2020). What Do Football Players  
425 Look at? An Eye-Tracking Analysis of the Visual Fixations of Players in 11 v 11 Elite  
426 Football Match Play [Original Research]. *Frontiers in Psychology, 11*(2624).  
427 <https://doi.org/10.3389/fpsyg.2020.562995>
- 428 Andrzejewski, M., Chmura, J., & Pluta, B. (2014). Analysis of motor and technical activities of  
429 professional soccer players of the UEFA Europa League. *International Journal of*  
430 *Performance Analysis in Sport, 14*(2), 504-523.
- 431 Araújo, D., Davids, K., & Hristovski, R. (2006). The ecological dynamics of decision making in sport.  
432 *Psychology of Sport and Exercise, 7*(6), 653-676.  
433 <https://doi.org/10.1016/j.psychsport.2006.07.002>
- 434 Araújo, D., Hristovski, R., Seifert, L., Carvalho, J., & Davids, K. (2017). Ecological cognition: expert  
435 decision-making behaviour in sport. *International Review of Sport and Exercise Psychology,*  
436 1-25.
- 437 Baptista, J., Travassos, B., Gonçalves, B., Mourão, P., Viana, J. L., & Sampaio, J. (2020). Exploring  
438 the Effects of Playing Formations on Tactical Behavior and External Workload During  
439 Football Small-Sided Games. *The Journal of Strength & Conditioning Research, 34*(7), 2024-  
440 2030.
- 441 Clemente, F. M., Martins, F. M. L., Wong, P. D., Kalamaras, D., & Mendes, R. S. (2015). Midfielder  
442 as the prominent participant in the building attack: A network analysis of national teams in  
443 FIFA World Cup 2014. *International Journal of Performance Analysis in Sport, 15*(2), 704-  
444 722.
- 445 Coutinho, D., Gonçalves, B., Travassos, B., Abade, E., Wong, D. P., & Sampaio, J. (2018). Effects of  
446 pitch spatial references on players' positioning and physical performances during football

447 small-sided games. *Journal of Sports Sciences*, 1-7.  
448 <https://doi.org/10.1080/02640414.2018.1523671>

449 Davids, K., Araújo, D., & Shuttleworth, R. (2005). Applications of dynamical systems theory to  
450 football. In T. Reilly, J. Cabri, & D. Araújo (Eds.), *Science and Football V: The Proceedings*  
451 *of the Fifth World Congress on Sports Science and Football* (pp. 537–550). Routledge.

452 Dellal, A., Chamari, K., Wong, D. P., Ahmaidi, S., Keller, D., Barros, R., Bisciotti, G. N., & Carling,  
453 C. (2011). Comparison of physical and technical performance in European soccer match-play:  
454 FA Premier League and La Liga. *European journal of sport science*, 11(1), 51-59.  
455 <https://doi.org/10.1080/17461391.2010.481334>

456 Di Salvo, V., Baron, R., Tschan, H., Montero, F., Bachl, N., & Pigozzi, F. (2007). Performance  
457 characteristics according to playing position in elite soccer. *International journal of sports*  
458 *medicine*, 28(3), 222-227.

459 Duarte, R., Araújo, D., Correia, V., & Davids, K. (2012). Sports Teams as Superorganisms:  
460 Implications of Sociobiological Models of Behaviour for Research and Practice in Team  
461 Sports Performance Analysis. *Sports Medicine*, 42(8), 633-642.  
462 <https://doi.org/10.2165/11632450-000000000-00000>

463 Folgado, H., Duarte, R., Marques, P., Gonçalves, B., & Sampaio, J. (2018). Exploring how movement  
464 synchronization is related to match outcome in elite professional football. *Science and*  
465 *Medicine in Football*, 2(2), 101-107. <https://doi.org/10.1080/24733938.2018.1431399>

466 Gai, Y., Volossovitch, A., Lago, C., & Gómez, M.-Á. (2019). Technical and tactical performance  
467 differences according to player's nationality and playing position in the Chinese football  
468 super league. *International Journal of Performance Analysis in Sport*, 19(4), 632-645.  
469 <https://doi.org/10.1080/24748668.2019.1644804>

470 Gibson, J. J. (1979). *The ecological approach to visual perception*. Houghton Mifflin Boston.

471 Gonçalves, B., Esteves, P., Folgado, H., Ric, A., Torrents, C., & Sampaio, J. (2017). Effects of Pitch  
472 Area-Restrictions on Tactical Behavior, Physical, and Physiological Performances in Soccer  
473 Large-Sided Games [Article]. *Journal of Strength and Conditioning Research*, 31(9), 2398-  
474 2408. <https://doi.org/10.1519/JSC.0000000000001700>

475 Headrick, J., Davids, K., Renshaw, I., Araújo, D., Passos, P., & Fernandes, O. (2011). Proximity-to-  
476 goal as a constraint on patterns of behaviour in attacker-defender dyads in team games.  
477 *Journal of Sport Sciences*, 30(3), 247-253. <https://doi.org/10.1080/02640414.2011.640706>

478 Hopkins, W. G., Marshall, S. W., Batterham, A. M., & Hanin, J. (2009). Progressive Statistics for  
479 Studies in Sports Medicine and Exercise Science. *Medicine and Science in Sports and*  
480 *Exercise*, 41(1), 3-12. <https://doi.org/10.1249/Mss.0b013e31818cb278>

481 Hughes, M., & Franks, I. (2008). *The essentials of performance analysis*. Routledge.

482 Hughes, M., & Probert, G. (2006). A technical analysis of elite male soccer players by position and  
483 success. *Notational Analysis of Sport-VII, Cardiff: UWIC*, 76-91.



484 Jordet, G., Aksum, K. M., Pedersen, D. N., Walvekar, A., Trivedi, A., McCall, A., Ivarsson, A., &  
485 Priestley, D. (2020). Scanning, Contextual Factors, and Association With Performance in  
486 English Premier League Footballers: An Investigation Across a Season [Original Research].  
487 *Frontiers in Psychology, 11*(2399). <https://doi.org/10.3389/fpsyg.2020.553813>

488 Konefał, M., Chmura, P., Zajac, T., Chmura, J., Kowalczyk, E., & Andrzejewski, M. (2019).  
489 Evolution of technical activity in various playing positions, in relation to match outcomes in  
490 professional soccer. *Biology of sport, 36*(2), 181.

491 Laakso, T., Davids, K., Liukkonen, J., & Travassos, B. (2019). Interpersonal Dynamics in 2-vs-1  
492 Contexts of Football: The Effects of Field Location and Player Roles [Original Research].  
493 *Frontiers in Psychology, 10*(1407). <https://doi.org/10.3389/fpsyg.2019.01407>

494 Laakso, T., Travassos, B., Liukkonen, J., & Davids, K. (2017). Field location and player roles as  
495 constraints on emergent 1-vs-1 interpersonal patterns of play in football. *Human movement*  
496 *science, 54*, 347-353.

497 Liu, H., Hopkins, W. G., & Gómez, M.-A. (2016). Modelling relationships between match events and  
498 match outcome in elite football. *European journal of sport science, 16*(5), 516-525.

499 Marques, M. C., Izquierdo, M., Gabbett, T., Travassos, B., Branquinho, L., & van den Tillaar, R.  
500 (2016). Physical fitness profile of competitive young soccer players: Determination of  
501 positional differences. *International journal of sports science & coaching, 11*(5), 693-701.

502 McGuckian, T. B., Cole, M. H., Jordet, G., Chalkley, D., & Pepping, G.-J. (2018). Don't turn blind!  
503 The relationship between exploration before ball possession and on-ball performance in  
504 association football. *Frontiers in Psychology, 9*, 2520.

505 Passos, P., Amaro E Silva, R., Gomez-Jordana, L., & Davids, K. (2020). Developing a two-  
506 dimensional landscape model of opportunities for penetrative passing in association football–  
507 Stage I. *Journal of Sports Sciences, 38*(21), 2407-2414.

508 Passos, P., Araújo, D., & Davids, K. (2013). Self-organisation processes in team sports: Implications  
509 for leadership. *Sports Medicine, 43*, 1-7. <https://doi.org/10.1007/s40279-012-0001-1>

510 Silva, P., Garganta, J., Araújo, D., Davids, K., & Aguiar, P. (2013). Shared Knowledge or Shared  
511 Affordances? Insights from an Ecological Dynamics Approach to Team Coordination in  
512 Sports. *Sports Medicine*(9), 765-772. <https://doi.org/10.1007/s40279-013-0070-9>

513 Travassos, B., Duarte, R., Vilar, L., Davids, K., & Araújo, D. (2012). Practice task design in team  
514 sports: Representativeness enhanced by increasing opportunities for action. *Journal of Sports*  
515 *Sciences, 30*(13), 1447-1454. <https://doi.org/10.1080/02640414.2012.712716>

516 Travassos, B., Gonçalves, B., Marcelino, R., Monteiro, R., & Sampaio, J. (2014). How perceiving  
517 additional targets modifies teams' tactical behavior during football small-sided games.  
518 *Human movement science, 38*, 241-250.

519 Vilar, L., Araújo, D., Davids, K., Travassos, B., Duarte, R., & Parreira, J. (2012). Interpersonal  
520 coordination tendencies supporting the creation/prevention of goal scoring opportunities in

521 futsal. *European Journal of Sport Sciences*, 14(1), 28-35.

522 <https://doi.org/10.1080/17461391.2012.725103>

523 Yi, Q., Groom, R., Dai, C., Liu, H., & Ruano, M. Á. G. (2019). Differences in technical performance  
524 of players from ‘the big five’ European football leagues in the UEFA Champions League.

525 *Frontiers in Psychology*, 10. <https://doi.org/10.3389/fpsyg.2019.02738>

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549 Table 1. Description of the independent variables

<b>Variables</b>	<b>Description</b>
<b>Team tactical behaviour</b>	
Ball possession	The time a team has possession of the ball during one attack
Players involved	The number of players involved in that attack during ball possession
<b>Participants' offensive actions</b>	
Successful passes	Number of successful passes made by the team from one player to each other
Diagonal and vertical passes	Number of diagonal and vertical passes a team completed in one attack
Lateral and backward passes	Number of lateral and backward passes a team completed in one attack
Penetrative passes	A pass that split the last line of defence and plays a teammate through to shoot at the goal
Dribbles	Successfully completed dribbles made by a participant past a player an opponent
<b>Players' defensive actions</b>	
Ball recoveries	A player successfully wins the ball back for his own team
Interception	A player successfully intercepts an opponent's pass
<b>Ball possession effectiveness</b>	
Lost balls	A team loses the ball possession to an opponent or the ball goes out of play after an attempted interception or tackle
Shots	A team ends the ball possession with a missing shot, a shot resulting in a goal, or a shot saved by a goalkeeper.

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564 **Table 2.** Inferences for the effects of the game scenarios comparisons on performance measures.

Variables	Teams' constitution			$\chi^2$	<i>p value</i> <i>d</i> <sub>Cohen</sub>		
	Defenders	Midfielders	Attackers		Def vs Mid	Def vs Att	Mid vs Att
<b>Team behaviour</b>							
Ball possession	6.81±4.73	6.94±4.09	8.07±5.11	1.72	-	-	-
Players involved	1.82±0.73	1.87±0.70	1.78±0.80	0.31	-	-	-
<b>Players' offensive actions</b>							
Successful passes	0.86±0.96	1.24±1.34	0.98±1.12	1.41	-	-	-
Diagonal and vertical passes	0.98±0.83	1.22±0.67	0.73±0.59	<b>8.75*</b>	0.32 0.31	0.39 -0.35	<b>0.00**</b> 0.71
Lateral and backward passes	0.31±0.51	0.55±0.76	0.38±0.67	1.48	-	-	-
Penetrative passes	0.12±0.44	0.5±1.08	0.48±0.99	4.09	-	-	-
Dribbles	0.18±0.39	0.16±0.37	0.53±0.78	<b>7.57*</b>	0.8 -0.05	<b>0.02*</b> 0.65	<b>0.01*</b> 0.66
<b>Players' defensive actions</b>							
Ball recoveries	0.12±0.39	0.13±0.34	0.10±0.30	1.27	-	-	-
Balls intercepted	0.22±0.42	0.11±0.31	0.13±0.33	2.74	-	-	-
<b>Ball possession effectiveness</b>							
Lost balls	0.28±0.45	0.57±0.64	0.65±0.74	<b>7.62*</b>	<b>0.03*</b> 0.53	<b>0.01*</b> 0.60	0.77 0.12
Shots at goal	1.28±0.84	0.63±0.78	0.95±0.98	<b>11.51**</b>	<b>0.00**</b> -0.80	0.19 -0.36	0.43 0.36

565 \* p&lt;.05; \*\* p&lt;.001

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