ISEAL
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TRANSFER OF SKILLS FROM FUTSAL TO FOOTBALL IN YOUTH PLAYERS

Final report

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Table of Contents

Introduction

A player's ability to read the game, choose the best available decision and accurately execute the related action, is essential for success in team sports such as football where the game dynamics change rapidly. Consequently, technical skills, such as ball control and passing, and perceptual skills underpinning decision making, such as who to pass the ball to, form the core of a player's development.

In this context, sport federations and coaches play an essential role in talent development by planning and delivering appropriate programs aimed at promoting the realisation of an individual's potential (T. Reilly, Bangsbo, & Franks, 2000). In more recent times, many UEFA members, such as Italy, England, Spain, etc., have introduced modified versions of football aiming to facilitate children's development by scaling the equipment and rules to the individual's needs and capabilities. Children start playing 5vs5 and then gradually move to 11vs11. The underlying rationale was that in 5vs5 and 7vs7 children are more involved in the action executing higher number of technical actions than 11vs11 (Capranica, Tessitore, Guidetti, & Figura, 2001).

Interestingly when mini-soccer was compared to futsal it has been demonstrated that youth players perform more technical actions in futsal compared to mini soccer (Milligan, Borrie, & Horn, 2008). Therefore, futsal could be a more appropriate training activity for young footballers. Furthermore, this idea has been promoted by many professional players and coaches. For example, Pele, one of the most iconic football players in the history of Brazil football, stated "Futsal requires you to think and play fast. It makes everything easier when you later switch to football"(FIFA, 2012). It is likely that the futsal ball, which is easier to control, promotes the acquisition of fine technical abilities and the higher player density on the pitch facilitates the development of perceptual skills that underpin sound decision making. However, there is a lack of scientific evidence and empirical research to support these anecdotes. In particular, it is unclear which specific abilities could be improved by practicing futsal and whether those abilities could be transferred to football.

The primary aim of this project is to investigate the transfer of technical and perceptual/decision making skills between futsal and football contexts in youth players. This project will be the first attempt to investigate the relationship between the two sports from a skill development perspective.

The results of this study will reveal whether futsal can consolidate the development of specific football related skills. It is important that current practice is based on scientific evidence rather than on 'lay' opinion (Thomas Reilly & Williams, 2003). Consequently, guidelines will be provided to sport federations and coaches in an effort to improve the current development programs and perhaps increase football participation.

Research questions

1. Does futsal practice facilitate the acquisition of superior technical and perceptual/decision making skills than football in youth individuals?
2. Are those skills transferable from futsal to football?
3. How do experience and age influence the transfer process?

Research hypotheses

1. Futsal players develop more efficient perceptual/decision making skills and quicker technical skills than football players.
2. The above mentioned skills are transferable from futsal to football, as futsal players will show a better performance in the football task than football players.
3. There is a general positive correlation between age/expertise and transfer, namely more expert players will show higher degree of transfer. However, the oldest groups may show a negative transfer due to a high specialization in their discipline.

State of knowledge

Transfer of learning has been defined as “the influence of previous experiences on performing a skill in a new context or on learning a new skill” ((Magill, 2011)p.190). The influence can be positive or negative. Positive transfer, as opposed to negative, occurs when previous experiences facilitate the performance of the new skill or in the new context. Consequently, the action of kicking the ball could be facilitated by previous football experience or could be interfered by previous swimming experience. In this context, some specific training activities can have a higher transfer than other activities. Therefore, it is essential to understand how the transfer works when designing training tasks.

Transfer occurs between tasks sharing similar elements, such as inter limb coordination or goal-directed movements (Thorndike, 1906); or sharing similar cognitive (Judd, 1908) or learning (Lee, 1988) processes. Other factors such as individual’s level of expertise (Rosalie & Muller, 2014), physical and social context (Barnett & Ceci, 2002) also influence the degree of transfer. In the context of movement skill acquisition, the individual’s patterns of coordination which refer to the intra and inter limb synchronization play an important role. If the body coordination developed through previous experiences matches with the demands of the new task, the transfer process is promoted (Kelso & Zanone, 2002).

The constraints-led approach contends that body coordination is shaped by the interaction between organismic, environmental and task constraints (Davids, Button, & Bennett, 2008). Organismic constraints, which refer to an individual’s attributes, and environmental constraints, such as light and temperature, are hardly controllable and manipulable in training settings. On the other hand, task constraints which represent the characteristics of the task, such as equipment and rules, can be manipulated during training. Consequently, coaches can promote the development of specific body coordination by manipulating the task constraints influencing, as consequence, the transfer of the learned skill.

Futsal and association football are both versions of football sharing similar components, such as parts of the body involved, and similar conceptual processes. Therefore, a certain degree of transfer is expected between the two disciplines. Furthermore, the task constraints of the two sports will shape the development of sport-specific coordination. This coordination will then influence a positive or negative transfer.

Previous research has investigated the ball type as a constraint on the development of technical skills showing improvement in participant's juggling and dribbling skills (Button, Bennett, Davids, & Stephenson, 1999). Furthermore, scaling tennis rackets has fostered the acquisition of strike techniques (Farrow & Reid, 2010). However, no previous research has investigated how task constraints promote skill transfer.

Consequently, this project will examine the influence of task constraints unique to futsal and football, namely ball/surface and player density, on skill transfer. Perceptual/decision making and technical skills will be assessed in youth players to investigate how the age/expertise affect the transfer process.

Methodology

Perceptual/decision making and technical skills of youth futsal and soccer players will be evaluated. The assessment of these sport-specific skills has to be performed in tasks that replicate the demands of the real match as testing conducted in the laboratory often lacks correspondence with the real-world (Dicks, Button, & Davids, 2010). Players have to perform sport-specific actions, e.g., passing the ball, in a sport-specific context, e.g., dynamic opponents and teammates. Therefore, matches would represent the ideal environment for this type of skill assessment. However, due to the complexity in controlling the large number of variables this is rarely achievable to directly measure player's abilities in a match context. The concept of representative design, which emphasizes the idea of replicating some match-specific variables and cues in semi-controlled assessment tasks, offers a solution to this issue (Pinder, Davids, Renshaw, & Araújo, 2011).

Representative tasks in futsal and football are used to assess the transfer of skills. Games have been designed to replicate the sport-specific environment. These tasks do not fully replicate the two sports but they replicate the most important variables and cues of the games, which are ball handling while interacting with teammates and opponents.

The task is a 5 versus 5 plus goalkeeper game. Ball, surface, and player density (pitch dimensions as a consequence) are the main variables which differentiate the two tasks:

1. Futsal task (FUT): this task is performed on a futsal surface with a futsal ball on a pitch of 24 by 15 meters, corresponding to a player density of 36 m^2 per player which is the most recurrent situation during official matches.
2. Football task (FOOT): this task is performed on a football surface with a football ball on a pitch of 24 by 36 meters, corresponding to a player density of 86 m^2 per player which reflects the real density during matches (Fradua et al., 2013).

Perceptual/decision making skill: perceptual skill refers to the ability of perceive environmental information and use that information to coordinate the most appropriate decisions. The high correlation between human vision and attention has lead researchers to evaluate eye movements as proxy of perceptual-cognitive process. Gaze behaviour is used to evaluate perceptual skill in the sport field as it has been found to discriminate between expert and less expert performers, specifically how they perceive the environmental information available to guide their action (Mann, Williams, Ward, & Janelle, 2007). Gaze behaviour is assessed using a mobile eye tracking device that uses head mounted cameras to record and track the pupil of the participant and determines their point of gaze. The optics of the eye tracker are connected, through a cable, to a recording box which is held in a small bag tightly fastened around the individual's waist. Video images are recorded during the experimental task allowing offline analyses of the gaze behaviour of each participant.

Subjects

A total of 67 youth players were recruited from elite futsal and football teams. They were divided in 6 groups according to age and discipline: U11 (n=12, 10.3 ± 0.8 years old), U13 (n=9, 12.3 ± 0.7 years old) and U15 (n=12, 14.5 ± 0.5) futsal; U13 (n=12, 12.6 ± 0.7), U14 (n=12, 13.4 ± 0.5) and U15 (n=12, 14.5 ± 0.7) football. All participants only play their own sport and none of them had a significant involvement (i.e., in an official club) in the other discipline.

Procedure

Each group performed three sessions. The first session aimed to familiarize the players with the equipment and procedure. In the second and third session players performed the FUT and FOOT tasks.

Each group of players was randomly divided in two teams of 6 players, plus a goalkeeper who is not part of the sample. The two teams played six, 5 vs 5 + GK games of 5 minutes in duration. During each game the gaze behaviour of two participants (one from each team) was assessed through the mobile eye device, whereas the technical skills of all players were evaluated throughout the tasks via camera recording. The two participants under gaze assessment were rotated in between tasks. Since the teams were composed of 6 players, one player per team rested during the game and these players wore the mobile eye in the following game (e.g. participants A and B rested during game 1 and wore the mobile eye in game 2). All the participants were assessed throughout the six games.

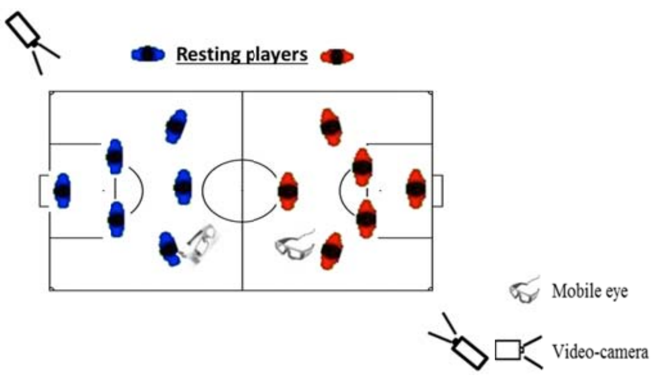

Figure 1 Scheme of the procedure

Data analysis

Gaze behaviour and technical skills associated with the most common action during the performance of both sports, that is controlling and passing the ball were evaluated. Throughout the gesture players have to coordinate vision, between the coming ball and the environment (e.g., teammate position and movement) to control the ball and make a decision. Their ability to alternate the gaze towards ball/environment and foot-ball coordination was evaluated.

The raw data of the eye tracker has to be manually coded to extract the point-of-gaze position (i.e., ball or environment) in each moment of the examined task. The dynamicity of the task affected the quality of the collected data and we developed a new coding method to overcome the issue.

Validation of a new gaze coding method

The mobile eye device computes the point of gaze superimposing the eye movements to the scene camera, which is oriented in front of the person capturing the field of view of the eye. The system tracks the eye, through the eye camera, using the reflection of the retina and the pupil (see pictures below).

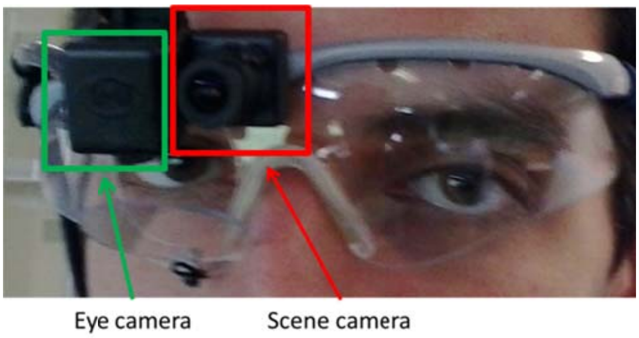

Figure 2 Mobile eye device

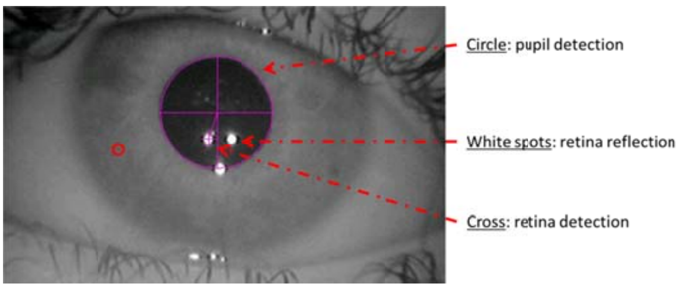

Figure 3 Eye camera view. The system uses pupil and retina reflection to acquire eye information.

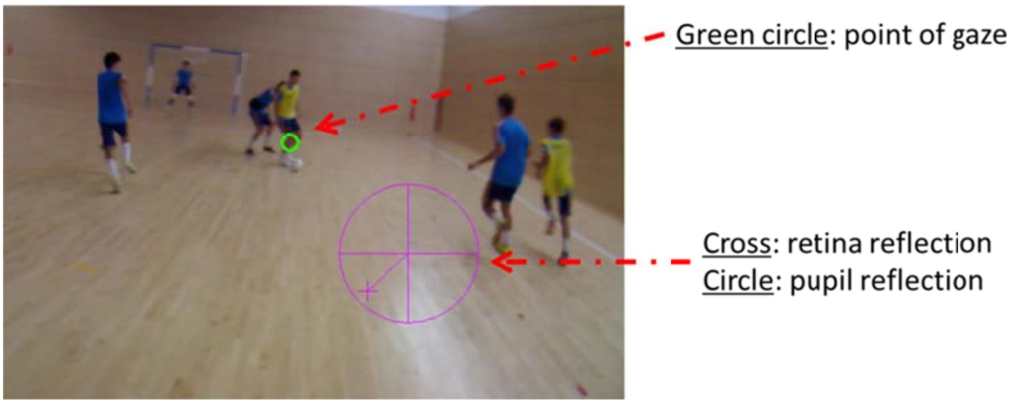

Figure 4 Scene camera view. Point of gaze superimposed on scene view using retina and pupil detection.

When the system is not able to capture these eye features, the point of gaze, which is the exact location the eyes are fixating, is missing or is not reliable. For this reason, the eye tracking technology has been mainly used in laboratory settings where the participant's head movement was restricted or in natural settings with participants performing static tasks to avoid the kind of issues. The literature in football – related to perception/decision making skill assessment, in fact, is based on studies examining players' eye movements during manual or verbal decision making tasks (Vaeyens, Lenoir, Williams, Mazyn, & Philippaerts, 2007; Williams & Davids, 1998). However, to provide new and more realistic/representative insight in football, we decided to employ the eye tracking technology during sport-specific unconstrained dynamic tasks, i.e. small sided games.

We performed a series of pilot tests and the eye videos were fairly unstable, with losses of pupil detection throughout the trials due to head vibration and quick head movements. In order to obtain reliable data we had to make a decision on whether to constrain players' field of action to limit head vibration or to leave the players free to play thus needing to create a new method to overcome the vibration issue. The second option is ideal for the above–mentioned reasons but it requires a new video analysis method. Therefore, we decided to explore and validate an alternative method to code the videos, without using eye features, that was reliable and consistent with the gold-standard eye coding.

Eye and head movements are correlated during natural/unconstrained human behaviour (Freedman, 2008).

When a gaze shift is performed, the neural signals firing neck and eye muscles are delivered almost simultaneously, with a slight anticipation towards the neck muscles (Zangemeister & Stark, 1981). Thus, assessing the movements of the head could be a reliable proxy of eye movements. The scene camera which is mounted on the goggle worn by the players follows the head movements and captures what is in front of the players as they move the head. Coding the objects, such as ball, teammates and opponents, within the scene camera video could then be related to the participants' point of gaze.

To validate a new method we performed a validity study comparing the standard point-of-gaze coding with a scene camera coding. We exported, from the Mobile Eye Software, the raw coordinates of the point of gaze in trials where the eye was properly and reliably detected, inspecting the scattering within the scene camera. We selected the data points corresponding to the period of time of our interest which goes from 2 seconds prior ball control to ball delivery/pass. The analysis showed that more than 85% of the gazes are located in a specific area (x = 150-350 and y = 50-350). Therefore, coding the objects inside this specific area (called "gaze window" from now on) could be highly correlated with the players' point of gaze.

We coded a total of 48 trials (12 players, 4 trials per player) following the two different methods: point of gaze and scene camera, using the gaze window. As stated earlier in the document we are interested in discriminating behaviours that focus on the ball and on the other players, so the coding has been designed to capture these two behaviours.

Eye coding: the point of gaze has been coded frame by frame (videos recorded at 30Hz: 30 frames per second), via Quiet Eye Solutions Software, providing its location during the course of the trial. The various objects in the scene have been clustered into two groups:

- Player-directed: the point of gaze was on opponents, teammates or free space (gaze above the closest player's feet).
- Ball/ground-directed: the point of gaze was on ball or grass (gaze below the closest player's feet).

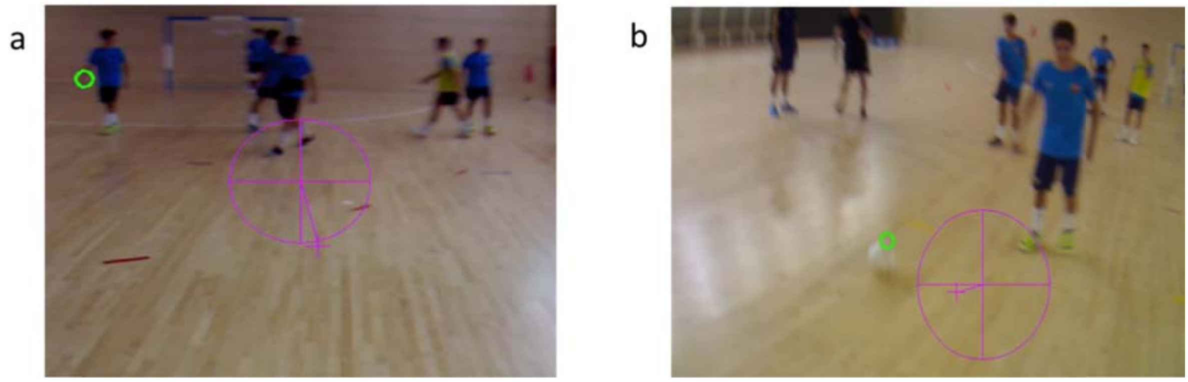

Figure 5 Point of gaze example. Player-directed (a) and ball/ground-directed (b).

Scene camera coding: this method aimed at examining the videos without using eye references, the point of gaze. Therefore, only the objects inside the empirical window have been coded frame by frame, via Sports Code v10, Sports Tec, Australia. Two behavioural groups have been created for this method too:

- Ball/ground-directed: when the ball was in the window.

  When the ball was NOT in the window the criterion to discriminate between this group and the other group was: BALL/GOUND-DIRECTED if less than a player's knee was visible in the window, PLAYER-DIRECTED when more than a player's knee was visible.

Figure 6 Window coding: ball/ground-directed group

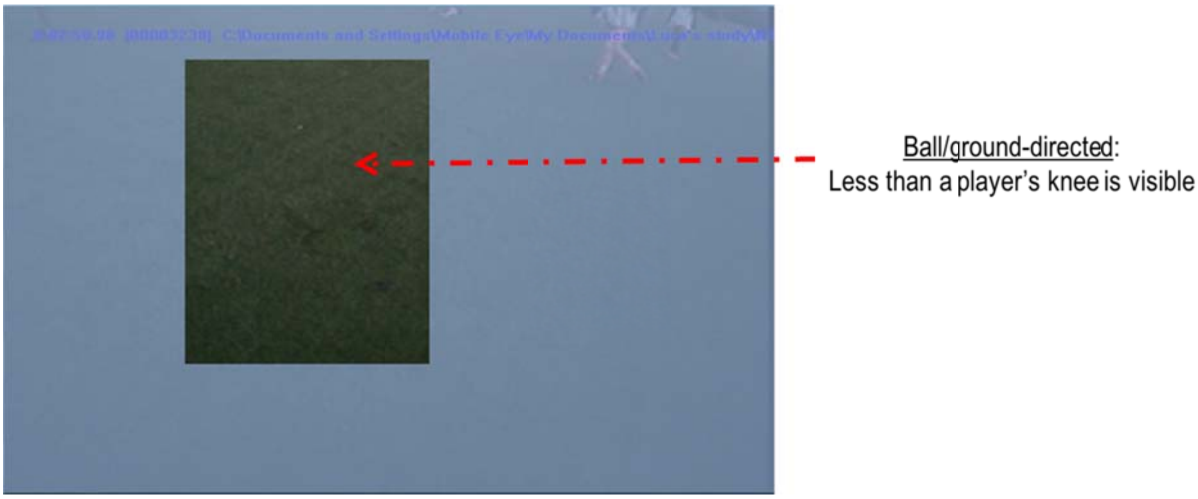

Figure 7 Window coding: ball/ground-directed group

- Player-directed: ball was NOT in the window and more than a player's knee was visible.

Figure 8 Window coding: player-directed group

Each coding data obtained through the point of gaze was compared with its counterpart obtained with the empirical window looking for agreement between the two methods. The analysis showed a 98% of agreement. However, the rate of agreement does not account for the agreements that would be expected by chances, so it overestimates the level of agreement. Cohen's kappa coefficient can be used to correct for this overestimation (Cohen, 1960) and the calculated value is 0.64 ($p<0.0001$), representing "substantial agreement" according to Landis and Koch's scale (Landis & Koch, 1977). The number of ball/ground behaviours is much higher than player behaviours, 2886 vs 541.

It's been argued that this discrepancy in numbers might cause a false Kappa coefficient and it's been proposed a prevalence adjusted kappa (PABAK) which provides a more realistic value (Di Eugenio & Glass, 2004). PABAK is 0.80 which represents "nearly perfect agreement".

These results showed that the new coding method was an excellent and reliable proxy of eye movements and it can be used to discriminate between ball/ground-directed and player-directed gaze behaviours in futsal and football players. The results obtained with this method are the same to the results obtained with the eye movement coding. Therefore, this method was followed in examining players' performance.

Variables

Each pass performed by the participant wearing the goggle, throughout the game, was considered and analysed as single trial. The overall action of receiving and passing the ball was divided in two phases: reception phase, which captures the period of time when the ball is rolling towards the participant with the goggle, and control phase, which goes from participants' first touch to the release of the pass.

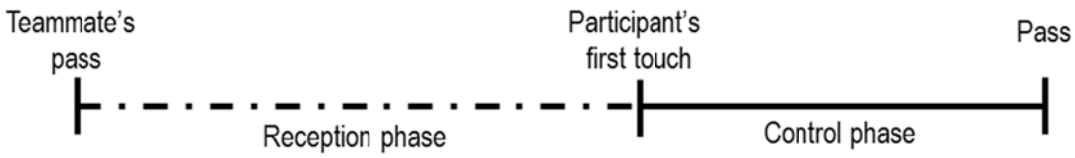

Figure 9 Phases of the examined action: reception and control

Players' gaze behaviour was evaluated separately for each phase.

Gaze behaviour was coded frame-by-frame to evaluate the player's attentional orientation, ball/ground-directed or player-directed, during the preparation and execution of each pass. The technical execution and contextual variables were evaluated through the footage from the external cameras. The software Sports Code was used to code the mentioned above variables.

The following variables were analysed:

- Gaze behaviour:
    - Percentage viewing time: refers to the percentage of time spent focusing on the two areas of interest, i.e., ball/ground and player. Only the ball/ground-directed percentages are reported in the results section, being easily generated by the coding software. Player-directed percentages can be obtained: 100-ball/ground percentage.
    - Gaze order: refers to the sequence/pattern of visual scan, which is the number of times the participants alternate the two gaze locations in each phase.
    - Player-directed timing: indicates the lapse of time from the beginning of the phase to the player-directed behaviour, in percentage of the whole phase time (e.g., 0% means that the player was directing the gaze to players from the beginning of the phase, 50% means that the player switch to player-directed half way through).
- Technical execution: execution time: refers to the period of time from the participant's first touch to the release of the pass.
- Pass outcome – pass performed by the player under assessment:
    - Accuracy: successful or unsuccessful. A pass was considered successful when the ball reached the teammate and ball possession was retained.
    - Decision: successful or unsuccessful. A decision was considered successful when the performed pass allowed the receiver to move forward (i.e., no opponent or very far opponent in front of him). This was defined with accredited coaches' opinions.
- Game-related variables: these variables were added to quantify the context in which the passes were performed.
    - Technical intensity of the game: refers to the number of technical actions (i.e., passes and shots) per minute performed during the game.

- Individual playing area: indicates the available playing area for the participant performing the pass. It can be considered as a tactical variable that influences a player's decision (Fradua et al., 2013). To calculate it, the pitch was divided in squares of known dimensions and the number of players inside the square the participant was in were counted. The dimension of the square was then divided by the number of players to get the individual playing area (e.g., in FOOT task, 108 m^2/5 players = 21.5 m^2/player).
- Reception time: refers to the time took the ball to travel from the teammate to the participant with the goggle (i.e., reception-phase time). This indicates how much time the participants had to prepare the reception and control action.

Results

The different age groups in futsal and football were collapsed in two groups, futsal and football, to better capture the differences. There was a substantial age difference between the groups and we decided to only include U13 and U15 in the analysis to have comparable sets of data. We, thus, ended up with a futsal group (U13 + U15) and a football group (U13 + U15).

The gaze, technical and game-related variables were compared between the two groups when they performed the FOOT and FUT task. A t-test analysis was performed to evaluate the statistical significance of the between-group differences. Significance was set at p<0.05. Furthermore, the effect size, which indicates the degree to which the phenomenon is manifested (Cohen, 2013), was analysed. The scale developed by Will Hopkins (Hopkins, 2002) was used to evaluate the magnitude of the effect size (table 1).

Trivial	Small	Moderate	Large	Very large	Nearly perfect	Perfect
0	0.2	0.6	1.2	2.0	4.0	infinite

Table 1 Scale of effect size magnitude.

To answer the research questions, we analyse the different variables in the following order:

1. Football – futsal comparison: we compared the data of football players performing FOOT and futsal players performing FUT (i.e., the performance in their own sport) to examine the differences between the two disciplines.
2. Transfer of skills from futsal to football: we compared the data of football and futsal players performing FOOT to evaluate whether futsal players transfer their skills to football.
3. Transfer of skills – a developmental perspective: we analyse the performance of futsal players in the FOOT task from a developmental perspective, comparing data of U13 and U15.

In each section, the results are presented with graphs and charts. Differences that are statistically significant are indicated with 'a' and the magnitudes of the effect size are indicated '**' for moderate to large effect and '*' for large to very large effect. Only effect sizes above 0.6 (i.e., 'moderate' threshold) were considered, as anything below 0.6 might not be practically relevant.

Football – Futsal comparison

'Are football and futsal different? Do football and futsal players behave and perform differently?'

The two representative tasks (FOOT and FUT), as proxy of futsal and football, are compared in this section. First, we analysed the game-related data to evaluate the different demands and characteristics of each sport. Then, the players' performance, when playing in their own discipline (i.e., football players in FOOT and futsal players in FUT) were analysed.

1. Game-related results

	Reception time (sec)	Individual playing area (player/m^2)	Technical intensity (1/minute)
Football	1.08 ± 0.17	46.54 ± 11.96	20.05 ± 1.32
Futsal	0.83 ± 0.13	24.94 ± 4.94	30.94 ± 2.08

Table 2 Game-related data of football group in the FOOT task and futsal group in the FUT task. The data is presented as mean ± SD.

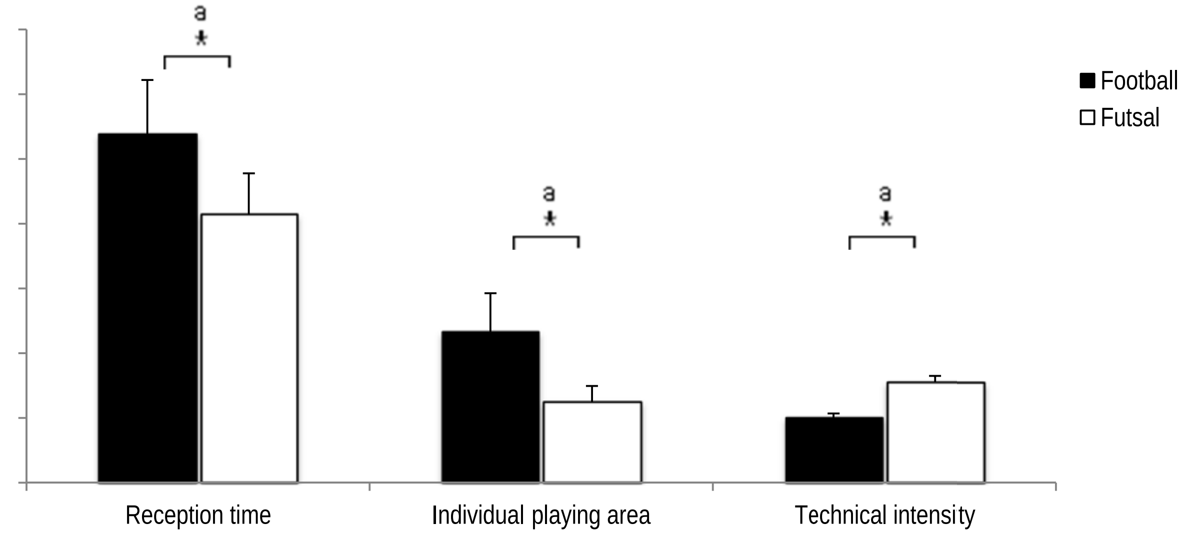

Figure 10 Game-related results of football group in FOOT and futsal group in FUT. “a” represents statistical difference, p<0.05. * represents large to very large effect size. ** represents moderate to large effect size.

The results showed that reception time and individual playing area were significantly lower in futsal, whereas technical intensity was significantly higher in futsal than football, with large to very large effect size in all the variables.

2. Performance-related results

	Reception phase			Control phase			
	Ball-directed gaze (%)	Player-directed timing (%)	Gaze order (# alternations)	Ball-directed gaze (%)	Player-directed timing (%)	Gaze order (# alternations)	Execution time (sec)
Football	0.88 ± 0.08	0.75 ± 0.11	0.76 ± 0.35	0.68 ± 0.18	0.34 ± 0.20	1.81 ± 0.71	1.72 ± 0.44
Futsal	0.83 ± 0.12	0.80 ± 0.13	0.79 ± 0.39	0.55 ± 0.18	0.19 ± 0.16	1.27 ± 0.70	1.10 ± 0.31

Table 3 Gaze behaviour and technical execution of football group in FOOT task and futsal group in FUT task, divided in reception and control phase. The data is presented as mean ± SD.

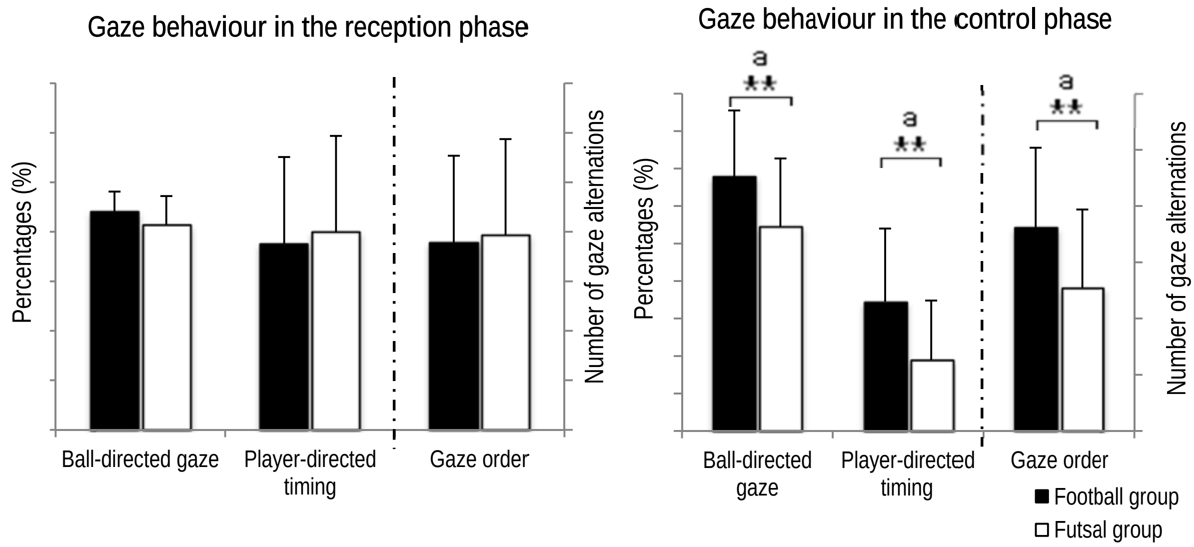

Figure 11 Gaze behaviour of football group in FOOT and futsal group in FUT, divided in reception and control phase. “a” represents statistical difference, p<0.05. * represents large to very large effect size. ** represents moderate to large effect size.

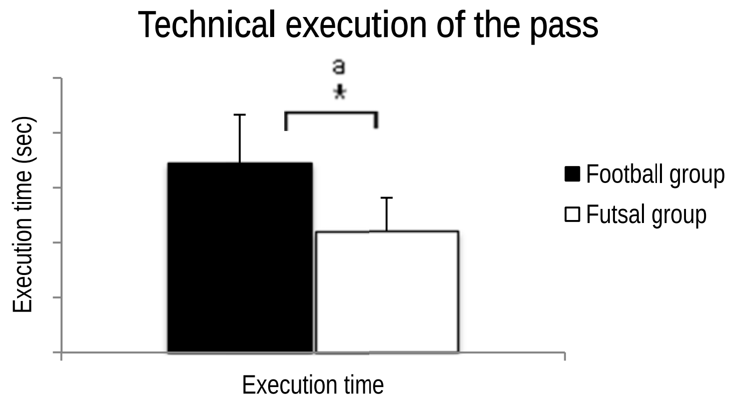

Figure 12 Technical execution of football group in FOOT and futsal group in FUT. “a” represents statistical difference, p<0.05. * represents large to very large effect size. ** represents moderate to large effect size.

The results showed no statistically significant differences in the reception phase. However, significant differences were present in the control phase. The futsal group was quicker in executing the action of receiving and passing the ball, with a large to very large effect size. The futsal group directed the gaze to the ball for less time, with a quicker timing of player-directed behaviour and the number of gaze alternations was lower. The effect size was moderate to large in all three gaze-related variables.

Transfer of skills from futsal to football

Do futsal players transfer their skills to football (i.e., do they perform better than football players in the FOOT task)?

This section shows the game-related and performance-related differences between futsal and football groups in the FOOT task.

1. Game-related results

	Reception time (sec)	Individual playing area (player/m2)	Technical intensity (1/minute)
Football	1.08 ± 0.17	46.54 ± 11.96	20.05 ± 1.32
Futsal	1.04 ± 0.16	41.68 ± 10.40	26.05 ± 1.05

Table 4 Game-related data of football group and futsal group in the FOOT task. The data is presented as mean ± SD.

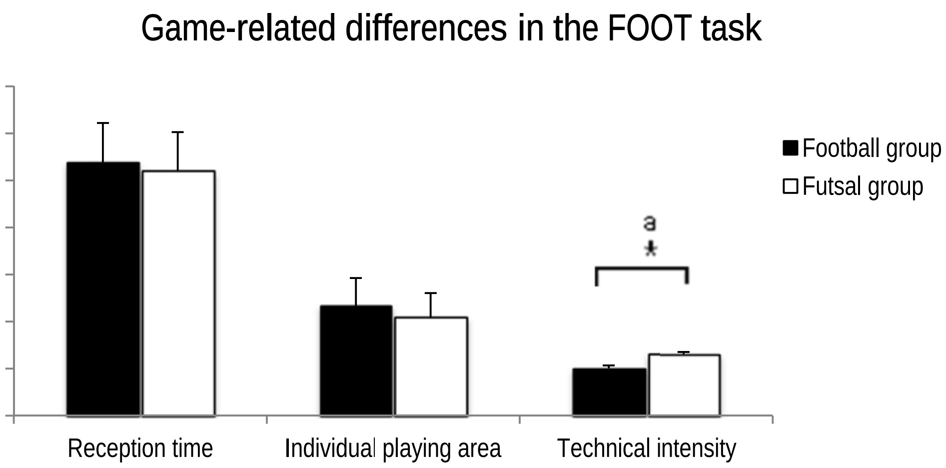

Figure 13 Game-related results of football group and futsal group in the FOOT task. "a" represents statistical difference, p<0.05. * represents large to very large effect size. ** represents moderate to large effect size.

The results show that only technical intensity was significantly different. The futsal group performed the FOOT task with a higher technical intensity, with a large to very large effect size. Reception time and individual playing do not statistically differ between groups.

2. Performance-related results

First, we examined the performance outcomes and the technical results. Since we compared the performance of two groups in the same task (i.e., FOOT task), the conditions should be similar to allow a comprehensive understanding of the differences. Therefore, technical intensity, being significantly different between the groups, was used as covariate for the performance outcomes. Then we examined the gaze behaviour differences between groups.

<u>Performance outcomes and technical data</u>

	Accuracy (%)	Decision (%)	Execution time (sec)	Covariate intensity Accuracy (%)	Covariate intensity Decision (%)
Football	0.80 ± 0.12	0.58 ± 0.12	1.72 ± 0.44	0.82 ± 0.12	0.62 ± 0.13
Futsal	0.84 ± 0.15	0.56 ± 0.17	1.25 ± 0.21	0.99 ± 0.14	0.68 ± 0.17

Table 5 Performance outcomes and technical execution of football group and futsal group in the FOOT task. The data is presented as mean ± SD.

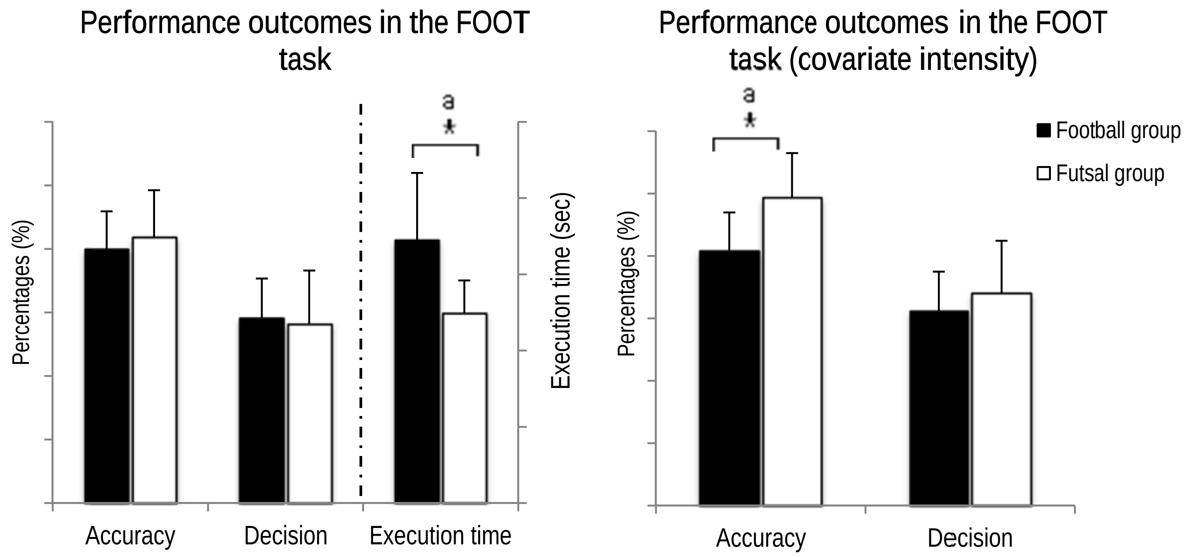

Figure 14 Performance outcomes and technical execution results of football group and futsal group in the FOOT task. "a" represents statistical difference, p<0.05. * represents large to very large effect size. ** represents moderate to large effect size.

The results showed a significant quicker execution time in the futsal group with large to very large effect size. Accuracy and decision were not significantly different. However, the between-group differences in accuracy became significant when we used technical intensity as covariate.

The futsal group was significantly more accurate than the football group, with a large to very large effect.

Gaze behaviour data

	Reception phase			Control phase		
	Ball-directed gaze (%)	Player-directed timing (%)	Gaze order (# alternations)	Ball-directed gaze (%)	Player-directed timing (%)	Gaze order (# alternations)
Football	0.88 ± 0.08	0.75 ± 0.11	0.76 ± 0.35	0.68 ± 0.18	0.34 ± 0.20	1.81 ± 0.71
Futsal	0.87 ± 0.07	0.78 ± 0.14	0.78 ± 0.44	0.64 ± 0.14	0.28 ± 0.17	1.40 ± 0.46

Table 6 Gaze behaviour data of football group and futsal group in the FOOT task, divided in reception and control phase. The data is presented as mean ± SD.

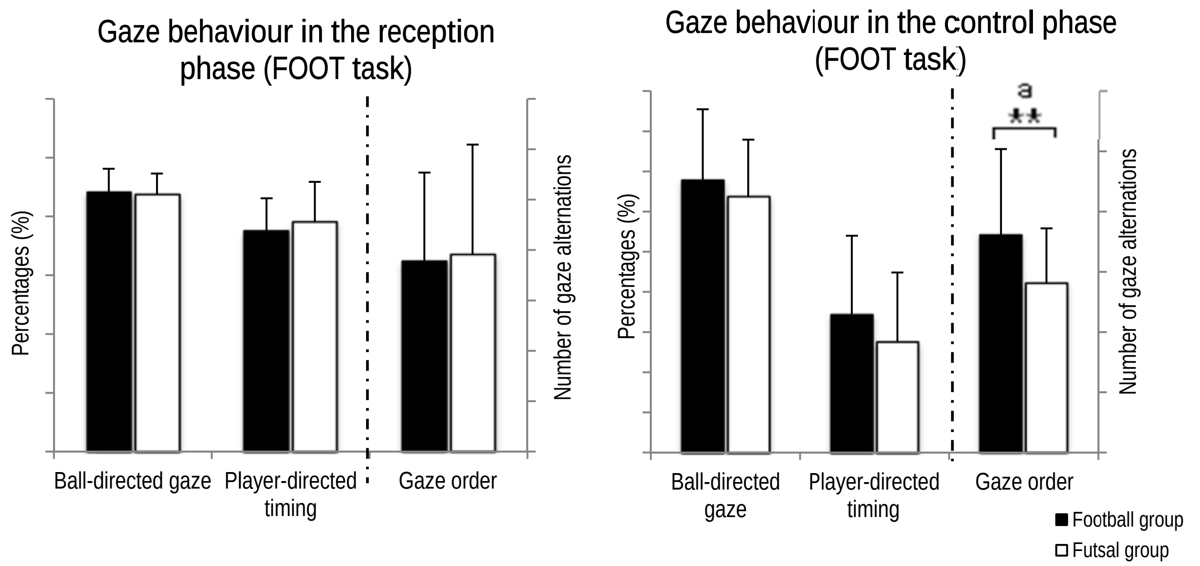

Figure 15 Gaze behaviour of football group and futsal group in the FOOT task, divided in reception and control phase. "a" represents statistical difference, p<0.05. * represents large to very large effect size. ** represents moderate to large effect size.

The only statistically significant difference was the gaze order, which was lower in the futsal group with a moderate to large effect size. The other variables were not statistically different between the two groups.

Transfer of skills – a developmental perspective

What would be the best age to switch from futsal to football?

This section analyses the performance-related differences between U13 and U15 futsal groups when performing the FOOT task.

Performance outcomes and technical data

	Accuracy (%)	Decision (%)	Execution time (sec)
Futsal U13	0.81 ± 0.18	0.49 ± 0.17	1.25 ± 0.19
Futsal U15	0.86 ± 0.12	0.62 ± 0.15	1.24 ± 0.24

Table 7 Performance outcomes and technical execution of U13 and U15 futsal groups in the FOOT task. The data is presented as mean ± SD.

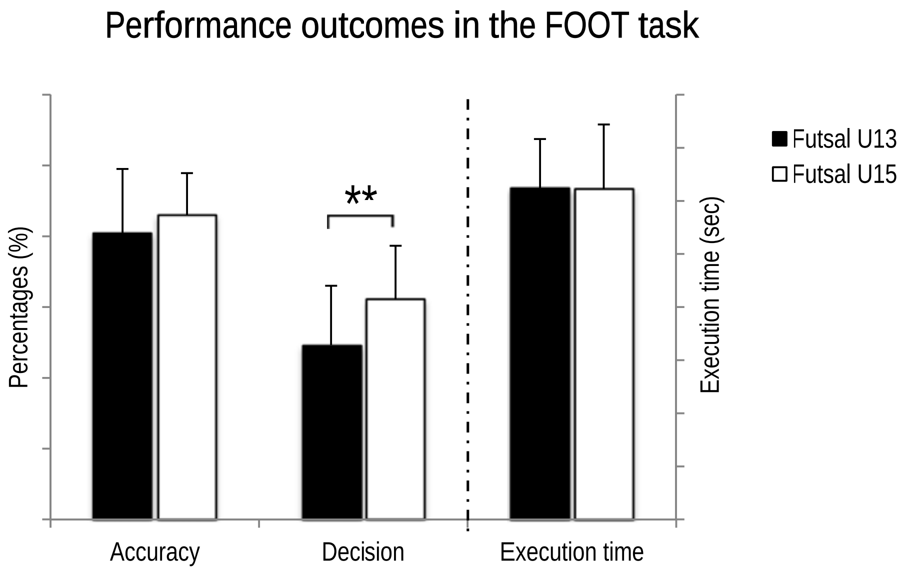

Figure 16 Performance outcomes and technical execution results of U13 and U15 futsal groups in the FOOT task. "a" represents statistical difference, p<0.05. * represents large to very large effect size. ** represents moderate to large effect size.

There were no statistically significant differences between the U13 and U15 futsal groups. However, the U15 group had a higher percentage of correct decisions than the U13 group with a medium to large effect size. This result was not statistically significant, potentially due to a small sample size.

Gaze behaviour data

	Reception phase			Control phase		
	Ball-directed gaze (%)	Player-directed timing (%)	Gaze order (# alternations)	Ball-directed gaze (%)	Player-directed timing (%)	Gaze order (# alternations)
Futsal U13	0.93 ± 0.06	0.84 ± 0.17	0.64 ± 0.42	0.62 ± 0.12	0.29 ± 0.13	1.41 ±0.50
Futsal U15	0.83 ± 0.05	0.73 ± 0.09	0.90 ± 0.43	0.65 ± 0.16	0.26 ± 0.21	1.40 ± 0.44

Table 8 Gaze behaviour data of U13 and U15 futsal groups in the FOOT task, divided in reception and control phase. The data is presented as mean ± SD.

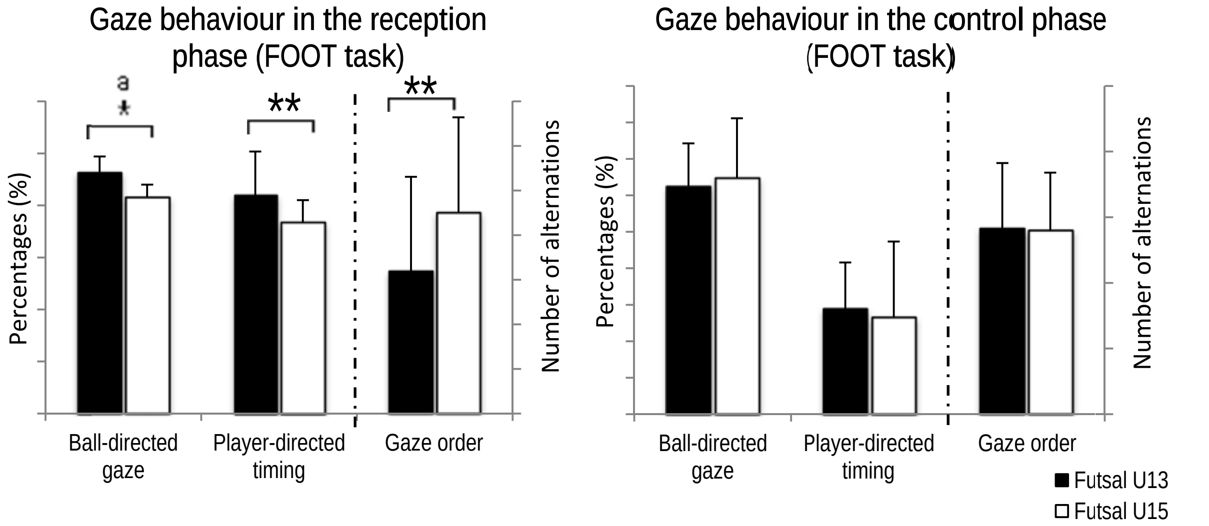

Figure 17 Gaze behaviour of U13 and U15 futsal groups in the FOOT task, divided in reception and control phase. “a” represents statistical difference, p<0.05. * represents large to very large effect size. ** represents moderate to large effect size.

The results showed differences in the reception phase, whereas there were no differences in the control phase. The U15 directed their gaze to the ball significantly less time than U13. Furthermore, player-directed timing was quicker in U15 and the number of gaze alternations was higher in the U15, with a moderate to large effect size in both variables. Player-directed timing and gaze order differences were not statistically significant.

Summary of the main results

The analysis of the collected data showed interesting results that can be summarised as follow:

1. Football – futsal comparison: analysis of the football group performing the FOOT task and the futsal group performing the FUT task:
    a. Game-related results: reception time and individual playing area were lower in futsal, whereas technical intensity was higher in futsal than football.
    b. Performance-related results: no differences in the reception phase. In the control phase, the futsal group directed the gaze on the ball for less time, the player-directed timing was quicker and the gaze order was lower than the football group. The technical execution of the pass was quicker in the futsal group.
2. Transfer of skills from futsal to football: analysis of the football and futsal groups performing the FOOT task:
    a. Game-related results: the futsal group performed the task at a higher technical intensity.
    b. Performance-related results: the technical execution of the pass was quicker in the futsal group. Furthermore, accuracy was higher in the futsal group when technical intensity was used as covariate. The only significant difference in the gaze behaviour was the gaze order, which was lower in the futsal group.
3. Transfer of skills – a developmental perspective: analysis of U13 and U15 futsal groups performing the FOOT task.
    a. Performance-related results: no statistically significant differences in performance outcomes and technical execution. However, the decision percentage was higher in the U15 group with a moderate to large effect size.

In the reception phase, the U15 group directed the gaze to the ball for less time, the player-directed timing was quicker and the gaze order was higher than the U13 group. No significant differences in the control phase.

Discussion

Anecdotal evidence suggests that futsal practice promotes the development of quick technical and decision making skills, and these skills can be transferred to football. However, no studies have properly investigated the issue and scientific evidence is needed to improve our understanding of the mechanisms underlying skill development and transfer. Therefore, we designed a study to investigate the influence of futsal and football demands in developing technical and perceptual-cognitive skills, and the transfer of these skills from futsal to football in youth individuals.

Football and futsal share similar components, such as parts of the body involved and perceptual processes. Hence, futsal may look like a small indoor version of football at first sight. However, a careful observation will reveal that the two sports present quite pronounced differences, e.g., game intensity, rules, movement kinematics, etc. On the one hand, these differences might promote quicker technical and perceptual skills in futsal, considering the intensity of the game demands. On the other hand, the similarities should promote transfer of skills between the two sports, as suggested by the similarities-based theories (Judd, 1908; Lee, 1988; Thorndike, 1906). Consequently, we hypothesised that in the action of receiving and passing the ball:

1. Futsal players develop more efficient perceptual/decision making skills and quicker technical skills than football players.
2. The above mentioned skills are transferable from futsal to football, as futsal players will show a better performance in the football task than football players.
3. There is a general positive correlation between age/expertise and transfer, namely more expert players will show higher degree of transfer. However, the oldest groups may show a negative transfer due to a high specialization in their discipline.

To test our hypotheses, we designed representative tasks (i.e., FOOT and FUT) that replicate the constraints of the two sports in the specific examined action (i.e., ball reception and delivery).

The between-group comparison of the performances of the football group in the FOOT task and the futsal group in the FUT task showed interesting significant results. All the game-related variables highlight the higher intensity of the futsal game compare to football. In the FUT task, players had less time to organise the reception of the ball, being lower the reception time; the action was performed with higher pressure, being lower the individual playing area; and the technical intensity of the game was higher than FOOT. This led to the development of different strategies and abilities to cope with the sport-specific demands. Futsal players have to develop specific coordination that allows them to efficiently perform the examined action in a really dynamic and challenging environment. In the control phase, they focused their attention longer on decision making-related areas (i.e., player-directed behaviour) and they alternated the gaze between ball and player in a more efficient way, namely less alternations with a quicker timing; in doing so, they controlled and passed the ball quicker than football players. However, it seems that game-related demands do not influence player's behaviour in the reception phase as futsal and football players behave similarly. Summarising, we can say that, as hypothesised, futsal game demands promote the development of quicker and, potentially, more efficient technical and perceptual-cognitive skills in youths. These results support the constraints-led approach view on skill acquisition (Davids et al., 2008), which argues that different task constraints (ball, rules, individual playing area, etc.) influence the development of perceptual-motor skills.

We were then interested in evaluating whether the skills developed in futsal could be transferred to a football environment. We, thus, analysed the performance of futsal players in the FOOT task and compared it to the football players. The between-group analysis showed significant differences in game-related and performance-related variables. The futsal group performed the task at a higher technical intensity with higher accuracy and decision percentages, executing the action quicker than the football group. In the control phase, futsal players more efficiently alternated their gaze between ball and player and, despite being not significant, they tended to direct their gaze quicker and for longer on player-related areas.

Being exposed to a more intense game, thus, fostered the development of quick perceptual-motor skills that facilitated the performance in a "less-demanding" environment (i.e., the FOOT task). The transfer process, indeed, is promoted when the body coordination developed through previous experience matches the demands of the new task (Kelso & Zanone, 2002). Therefore, even though futsal players were not accustomed to the football environment, they outperformed the football players. We can conclude that youth futsal players were able to transfer their skills to football. The results confirmed our hypothesis, ground on similarities-based theories (Judd, 1908; Lee, 1988; Thorndike, 1906).

Finally, having the evidence that futsal promotes the acquisition and transfer of more efficient perceptual-motor skills; we evaluated the transfer process from a developmental perspective. The between-groups analysis of U13 and U15 futsal players in the FOOT task showed little differences. The U15 group focused for longer and with a quicker timing on player-directed areas but the number of gaze alternations was higher than the U13 group. There were no significant differences for performance outcomes but the U15 group showed a higher decision percentage with moderate to large effect size. Therefore, no big differences were apparent between the two groups but the higher decision percentage in the U15 group suggests that older futsal players, hence with more experience, had a slight better transfer of decision making skills to football. Summarising, age and experience play a role in the transfer of skills from futsal to football and it seems that older players have more transfer. However, we only evaluated U13 and U15 age-groups and we cannot make definite conclusions on the recommended age to switch from futsal to football. More data from different age groups is needed to further evaluate the effect of age and experience on the transfer process. We can say, however, that individuals can practice futsal until the 15^{th} year of age and then be able to positively transfer passing-specific perceptual-motor skills.

Summarising, the results of this study provide evidence that supports the anecdotal belief that futsal practice can foster the development of football-related skills. Even though the sample size was limited, statistically significant results were obtained.

This study focused on the perceptual-motor skills associated with the action of receiving and passing, hence the conclusions are only relevant to that. The conclusions can be recapitulated as follow:

1. Football and futsal game demands constrain the development of sport-specific skills. Futsal promotes quicker and more efficient perceptual-motor skills (i.e., gaze behaviour and technical execution of the skill).
2. Futsal players are able to transfer their skills to a football task as they outperformed the football players in the FOOT task.
3. The trend of U13 and U15 results suggests that 14/15 years of age might be a good period to switch to football. However, no definite conclusions can be made for this issue.

This study provides evidence of the transfer of perceptual-motor skills during ball reception and delivery from futsal to football. However, this is just the first step as the transfer issue is complex and more research is needed to further examine the behaviour of futsal players in a football scenario, such as off-side decision making, tactical behaviour, etc.

Practical implications

This study provides scientific evidence that has significant implications in various football-related aspects, at different levels. This new valuable information can assist UEFA and national sport organisations in making strategic decisions, and football practitioners in planning appropriate training routines. The potential impact of futsal can be examined at two levels: inside the football code, as tool to improve football-related skills; and outside the field, to increase football (as general term) participation across Europe.

Football coaches could implement futsal drills in their training plans to enhance players' perceptual-motor skills. As shown in this study, futsal practice fosters the development of quick technical and decision making skills in the action of receiving and passing the ball. Therefore, practitioners might introduce the practice of futsal in the weekly training design to improve their athletes' capability of performing successful passes. Furthermore, the career path to become a professional football player might change. Football organisations and clubs may encourage kids to start playing futsal and then move to football at the appropriate age.

Association football is the most popular sport in the world (Sportek, n.a.) and its popularity drive individuals to get involved and participate. However, popularity might not be enough and proper facilities, policies and organisations are required to grow the participation rate and limit the dropout. In this context, futsal might play an important role. Futsal requires fewer infrastructures than football, being the pitch half the size of a football one, and it can be played year-round in any type of weather. Futsal, as opposed to football, can be practiced in schools and most schools in Europe have a gymnasium but not many have a football pitch. Furthermore, the futsal ball is always played on the ground and the probabilities of ball headings, which are a serious issue for kids' brain development (de Menezes, 2015; Moser & Schatz, 2002), are very limited. All these feature, plus knowing that futsal can start a football career, might promote the increase of kids' football participation across Europe.

Even though outside the scope of this study, it is worthwhile mentioning that any strategy that encourages sport participation and physical activity in youths should be highly valued for the potential health-related outcomes. The high correlation between sport participation and positive health behaviours is well known (Pate, Trost, Levin, & Dowda, 2000). The practicality and the enjoyment of the game might place futsal in a good position in promoting sport participation and positive health behaviour. As a consequence, football participation can grow even more. However, scientific evidence is needed to support this personal view.

Summarising, the information of this study may be beneficial to UEFA in potentially improving the coaching programs, especially at grassroots level, and increasing football participation across Europe.

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