ORIGINAL ARTICLE

The impact of visual occlusion during small-sided games on youth football players

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ABSTRACT

This study aimed to investigate the effects of playing with visual occlusion (OCC) during small-sided games (SSG) performed under different pitch sizes on youth players' physical and technical performance. The purpose was to understand how visual occlusion may influence players' behaviour and performance in game-based scenarios. Thirty youth football players from a U14 football academy participated in the study. The design involved a repeated-measures approach, with players exposed to different experimental conditions: normal situation (NOR) without OCC; OCC with an eye patch on the dominant foot's corresponding eye. The SSGs were performed on both small and large pitch sizes. Time-motion variables were computed using positional data, and technical analysis was based on video footage. A repeated measures analysis of variance was conducted to identify differences in the considered variables between the conditions. Although no significant effects were found in technical performance between NOR and OCC conditions, suggesting adaptability to OCC constraints, some trends were observed. Increasing pitch size in the NOR scenario led to higher physical demands and more touches with the dominant foot, while smaller pitches led to an increase in the number of passes. Larger pitches with OCC increased physical demands. Players tended to use their non-dominant foot more in smaller pitches with OCC. Furthermore, OCC in larger pitches significantly reduced the game pace, movements, and dribbling frequency, allowing more time for decision-making based on environmental information. Playing with visual occlusion may impact players' behaviour and performance, leading to adjustments in the use of dominant and non-dominant feet.

Keywords: Youth football, Visual occlusion, Dominance.

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INTRODUCTION

Football can be defined as a visually complex sport because, due to its highly situational nature, players must frequently adapt to rapidly changing dynamics (D'Isanto, 2019; Erickson, 2007). It is a sport that provides numerous opportunities to stimulate the visual system dynamically, given the need to make immediate decisions based on the demands of different phases of play (Alesi et al., 2015; Esposito & Raiola, 2020). To progressively improve players' decision-making and, consequently, their performance on the field, it could be very beneficial to start training visual skills from a young age (D'Elia, 2023; González-Víllora et al., 2015). Experienced footballers rely on perceptual-cognitive skills to recognize opponents' action patterns, triggering rapid selection of response and motor execution (De Waelle et al., 2021; Fadde & Zaichkowsky, 2018). Training such skills not only helps to better calculate the trajectory of the ball or anticipate the movements of teammates and opponents; it also greatly enhances peripheral vision, reaction times, and, above all, the ability to remain focused throughout the duration of the game (Esposito et al., 2019; 2020).

Although several studies have highlighted the importance of perceptual-cognitive skills prior to executing the pass and the influence of passing on overall performance in football (McGuckian et al., 2018; 2019; Müller & Abernethy, 2014), the number of studies examining the impact of perceptual-cognitive skills training on the technical fundamentals of passing is limited. A frequently used method to train perceptual-cognitive skills is visual occlusion, which involves limiting part of an athlete's vision while they are engaged in performing a specific motor task (Mann et al., 2010).

Visual occlusion is a concept that can be examined from various theoretical perspectives in the fields of perception and motor control (D'Elia et al., 2023). Two of these important perspectives are the ecological-dynamic approach and the Constraints-led approach (CLA). The ecological-dynamic approach emphasizes the importance of the surrounding environment and sensory information in organizing motor behaviour (Araujo et al., 2006; Correia et al., 2013). In this context, visual occlusion can be seen as a variation in the visual environment that affects how we perceive and respond to stimuli. This approach highlights how visual information is actively utilized by the motor system to guide behaviour (Raiola, 2017).

On the other hand, CLA focuses on the restrictions or constraints that influence motor behaviour. These constraints can be biomechanical, cognitive, or perceptual in nature (Altavilla, 2020; Newcombe et al., 2019). Visual occlusion can represent one of the perceptual constraints shaping motor behaviour. In this case, CLA examines how the presence of opponents and visual occlusion influence player choices and motor execution. Both of these theoretical perspectives provide a useful framework for understanding visual occlusion and its impact on motor behaviour. The choice of approach often depends on the specific study context and research objectives, but both underscore the importance of visual information and environmental or motor constraints in motor control.

Laterality in football is another relevant aspect to consider, as it can influence players' performances during the practice of this sport (Petro & Szabo, 2016). Laterality indicates the tendency to use one side of the body predominantly over the other, such as in the case of the dominant hand, foot, and eye. These aspects are closely related to motor coordination and can have a significant impact on agility, precision, and speed of actions on the field.

Several studies have investigated laterality in football players, focusing primarily on the use of the dominant foot in performing technical gestures (Bozkurt & Kucuk, 2018; Frontani et al., 2022; Zago et al., 2014).

However, attention to ocular dominance in football is limited, despite its potential crucial role in visual perception and reaction abilities during the game (Laksono & Rachman, 2020).

Some studies suggest that ocular dominance may be correlated with the ability to capture and process information more rapidly, providing players with an advantage in reading the field and making immediate decisions (Laby & Kirschen, 2011; Zouhal et al., 2018). However, despite these advantages, it can be beneficial to also train the non-dominant eye in young football players through occlusion of the dominant eye. This type of training aims to reduce any asymmetries in visual perception, improving peripheral vision and the ability to effectively use both feet during gameplay. A pronounced asymmetry between the dominant and non-dominant eye may also lead to a higher risk of injuries, as the body may not react adequately to unforeseen situations.

However, it is important to emphasize that the effectiveness of occlusion may vary significantly from one individual to another. Some footballers may benefit more from it, while for others, it may have a negligible or even negative impact on performance. Laterality is a highly individual aspect, and its influence on performance is subject to multiple variables, including the player's level of experience, the type of action performed, and the context of the game. Coaches and players should carefully consider the individual aspects of laterality and evaluate whether the use of visual occlusion could be helpful in enhancing specific performances during training sessions and matches (Vaeyens et al., 2007).

This study aimed to investigate the effects of playing with visual occlusion (OCC) during small-sided games (SSG) performed under different pitch sizes on youth players' physical and technical performance. The purpose was to understand how visual occlusion may influence players' behaviour and performance in game-based scenarios.

MATERIAL AND METHODS

Participants

Twenty Under-14 amateur football players (age: 12.6 ± 0.4; height: 170.5 ± 3.0; weight: 70.6 ± 3.8) who belonged to the same team competing at the regional level participated in this study. Each participant had a normal or corrected-to-normal vision and about 6 years of experience in the sport. The experimental procedure, risks and benefits were explained to the parents before participation. Informed consent was signed by the subjects' parents or legal guardians. The study adhered to the ethical code of the Declaration of Helsinki, and procedures were in line with established ethical standards in sports sciences (Winter & Maughan, 2009).

Study design

The methodology utilized a repeated measures approach, exposing players to various experimental conditions: normal situation (NOR) without visual occlusion, and visual occlusion with an eye patch covering the dominant foot's corresponding eye.

Small-sided games (SSG) were conducted on fields of different dimensions following the design outlined by Santos et al. (2022). The study employed a specialized training format called Gk+4vs4+Gk Small-Sided Game (SSG) to investigate the effects of different experimental scenarios on player performance. These scenarios included:

- Normal condition (NOR) in a small pitch size (40x30m): Players participated in SSG without visual occlusion, allowing uninhibited vision and movement within the smaller pitch dimensions.

- Visual occlusion (OCC) in a small pitch size (40x30m): Players wore eye patches covering the dominant foot's corresponding eye during SSG, simulating restricted vision to assess its impact within the smaller pitch area.
- Normal Condition in a larger pitch size (50x35m): Players engaged in SSG under normal conditions but within a larger pitch size, altering the spatial context compared to the smaller pitch.
- Visual Occlusion in a larger pitch size (50x35m): Players wore eye patches during SSG, similar to the previous condition, but in the context of the larger pitch size.

By implementing these conditions, the study aimed to examine the effects of increasing pitch size with and without visual occlusion, as well as the specific impacts of playing under visual occlusion in both small and large pitch sizes.

The testing procedures were carried out in six sessions on non-consecutive days. The first three sessions were devoted to familiarizing the players with the experimental scenarios. Subsequently, three evaluation sessions were conducted to assess the players' performance. After a warm-up period, players were introduced sequentially to a small and a large field. Within each field, players engaged in two 5-minute games interspersed with 2-minute rest periods, with a 10-minute break between field transitions. Therefore, each player participated in three 5-minute games per experimental scenario on both fields, for a total of 12 Small-Sided Games (SSG).

Data collection

The variables related to movement time were calculated using positional data (GPS), while the technical analysis was based on video recordings. A repeated measures analysis of variance was conducted to identify any differences between the conditions considered.

The data collection was conducted using highly precise instruments capable of recording both quantitative and qualitative data. In particular, the instruments deemed useful for the research included:

- GoPro HERO8: A high-frequency digital video camera (240 frames per second) used for image and video acquisition.
- K-50 Wearable Tech: A wearable GPS technology with a sampling frequency of 50 Hertz used for analysing workouts and matches.

Statistical analysis

Shapiro-Wilks tests were carried out to analyse if all variables were normally distributed within each group and evaluation moment. A repeated measures analysis of variance was conducted to identify differences in the considered variables between the conditions. Data were reported as Mean (SD) for all variables. Statistical significance was set at $p < .05$. Data analyses were performed using IMB SPSS Statistics (Version 27 for Windows; IBM, Armonk, NY, USA).

RESULTS

Table 1 presents the variations in variables measured across different game scenarios in soccer, divided by pitch size (small and large) and experimental condition (NOR: Normal situation without occlusion, OCC: Visual occlusion).

In terms of player movement, it was found that on larger pitches, players covered greater distances overall compared to smaller pitches ($p < .001$). Specifically, walking distances were significantly higher on smaller pitches (p < .001), while running distances were notably higher on larger pitches (p < .001). Sprinting distances also showed significant differences based on pitch size (p < .002).

Table 1. Variations in variables across different game scenarios.

Variables	Game Scenarios (mean ± SD)				F	*p*
	NOR small pitch	OCC small pitch	NOR large pitch	OCC large pitch		
Total distance covered (m)	499 ± 23.4	455 ± 41.8	525 ± 68.4	523 ± 63.7	12.6	<.001*
Walking (<7.0 km/h)	220.5 ± 22.3	228 ± 14.8	215.3 ± 25.7	244 ± 29.8	10.3	<.001*
Running (10.0 - 12.0 km/h)	37.2 ± 12.8	38.6 ± 14.2	65.4 ± 18.9	44.7 ± 26.8	8.7	<.001*
Sprinting (12.1 - 14.0 km/h)	18.1 ± 11.2	12.5 ± 10.1	21.6 ± 15.3	22.9 ± 13.6	5.92	<.002*
Shots						
Dominant foot	0.8 ± 0.6	1.0 ± 1.1	0.8 ± 0.8	1.0 ± 1.0	0.267	.779
Non-dominant foot	0.18 ± 0.3	0.30 ± 0.45	0.18 ± 0.3	0.12 ± 0.32	0.49	.697
On Target	0.5 ± 0.6	0.8 ± 0.8	0.6 ± 0.8	0.8 ± 0.8	0.611	.612
Off Target	0.4 ± 0.5	0.3 ± 0.4	0.3 ± 0.4	0.2 ± 0.5	0.29	.778
Dribbles						
Successful	1.2 ± 1.25	0.9 ± 1.07	1.5 ± 1.1	0.9 ± 1.2	0.954	.401
Unsuccessful	0.71 ± 0.91	0.59 ± 0.79	0.12 ± 0.8	0.3 ± 01.3	0.719	.524
Touches						
Dominant foot	14.1 ± 3.2	9.2 ± 6.1	13.8 ± 7.6	14.7 ± 7.3	2.67	.071
Non-dominant foot	4.8 ± 2.2	1.6 ± 1.7	2.6 ± 1.6	3.5 ± 2.0	1.48	.258
Passes						
Dominant foot	6.2 ± 2.7	5.1 ± 2.4	5.3 ± 2.5	4.9 ± 2.3	2.71	.071
Non-dominant foot	1.0 ± 0.9	0.9 ± 1.0	0.8 ± 0.8	0.4 ± 0.6	1.24	.312
Successful	6.1 ± 2.7	5.0 ± 2.4	4.6 ± 2.3	4.1 ± 2.0	4.03	.002*
Unsuccessful	1.2 ± 1.4	0.6 ± 0.8	1.0 ± 1.2	0.8 ± 0.9	0.724	.577

Interestingly, there were no significant differences observed in the number of shots taken with dominant and non-dominant feet across the different scenarios. Similarly, the success rate of dribbles did not vary significantly between experimental conditions.

When examining ball interactions, the number of touches with the dominant foot exhibited a trend towards significance between pitch sizes (p = .071), suggesting potential differences in ball control strategies. Notably, successful passes significantly differed between pitch sizes, with smaller pitches showing higher success rates (p = .002).

DISCUSSION

Despite no significant effects being observed on technical performance between the NOR and OCC conditions, suggesting that players adapt well to the constraints of visual occlusion, some trends emerged. Increasing the field size in the NOR condition resulted in greater physical demand and increased use of the dominant foot, while smaller fields led to an increase in the number of passes.

In larger fields with visual occlusion, higher physical demands were observed. Furthermore, players showed a greater propensity to use the non-dominant foot in smaller fields with visual occlusion. Visual occlusion in wider fields instead significantly slowed down the pace of play, movements, and dribbling frequency, making the decision-making process more influenced by environmental information. In larger fields, players covered greater distances and reached higher speeds during visual occlusion compared to the normal situation.

The results demonstrate how visual occlusion can influence players' behaviour and performance, leading to changes in the use of both dominant and non-dominant feet. Coaches might consider varying field dimensions to increase physical demands during training. Additionally, using smaller fields could be beneficial in emphasizing teamwork and encouraging players to effectively develop their non-dominant foot in visually occluded scenarios. It has been shown that performing under sub-optimal visual conditions can encourage individuals to use their limited viewing time more efficiently or to effectively utilize additional sensory information, such as auditory and/or proprioceptive cues (McGuckian et al., 2019). The reduction of visual information can potentially lead to a greater sense of attention, which in turn can focus attention externally to the task, rather than internally (Raiola, 2014; Wilkins & Appelbaum, 2019).

The use of spatial occlusion also allows for the improvement of basic visual perception, temporary attention, the ability to anticipate trajectories, and short-term memory. To date, two studies have been conducted using this particular form of visual occlusion, specifically in basketball and soccer (Dunton et al., 2019). Although research on spatial occlusion has provided a new paradigm for understanding how athletes utilize visual information to identify the outcomes of specific sports activities, there is currently a lack of studies examining the effectiveness of spatial occlusion as a training method. The analysis of laterality in football provides a clear understanding of the importance of this aspect on sports performance. It is a relevant aspect in football as it influences agility, precision, and speed of actions on the field. Aspects related to laterality, such as foot and eye dominance, can have a significant impact on motor coordination and, consequently, on the execution of technical movements.

Several studies have focused on analysing laterality in football players, primarily focusing on the use of the dominant foot during technical actions (Pietsch & Jansen, 2018; Stöckel & Carey, 2016; Verbeek et al., 2017). However, ocular dominance, despite its crucial role in visual perception and reaction abilities during gameplay, has often been overlooked. Ocular dominance appears to be correlated with the ability to quickly process information, providing an advantage to players in reading the field and making immediate decisions. Therefore, it is of paramount importance to carefully consider laterality, with particular attention to ocular dominance, in order to maximize individual performance in football.

The study's practical applications highlight the benefits of incorporating visual occlusion and varied field dimensions into football training sessions. By doing so, coaches can enhance players' adaptability, teamwork, decision-making skills, and overall performance on the field. This approach not only challenges players to excel under sub-optimal conditions but also fosters a deeper understanding of the role of laterality, particularly ocular dominance, in maximizing individual performance.

CONCLUSIONS

Playing with visual occlusion may impact players' behaviours and performance, leading to adjustments in the use of dominant and non-dominant feet. Coaches can consider adjusting pitch sizes to increase physical demands. Additionally, smaller pitches can be used to emphasize passing and encourage players to use their non-dominant foot effectively during OCC scenarios. Furthermore, implementing specific training drills that simulate visual occlusion scenarios can help players improve their decision-making and spatial awareness skills. Encouraging players to practice using both feet equally during regular training sessions can aid in developing ambidextrous skills, beneficial in various game situations. Providing feedback and reinforcement to players when they successfully use their non-dominant foot during matches or training exercises can reinforce the importance of this skill. Finally, incorporating video analysis sessions to review player performance during visual occlusion drills can identify areas for improvement or refinement in technique and decision-making.

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No potential conflict of interest were reported by the author.

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