Science and Medicine in Football

ISSN: 2473-3938 (Print) 2473-4446 (Online) Journal homepage: www.tandfonline.com/journals/rsmf20

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To cite this article: Jade O'Brien-Smith, Mitchell R. Smith, Pieter Vansteenkiste, Job Fransen, Linus Zeuwts, Kyle J. M. Bennett & Matthieu Lenoir (2025) Understanding the role of gaze behaviour and coaching experience in the assessment of youth soccer teams, Science and Medicine in Football, 9:2, 163-171, DOI: 10.1080/24733938.2024.2325135

To link to this article: https://doi.org/10.1080/24733938.2024.2325135

Published online: 21 Mar 2024.

SCIENCE AND MEDICINE IN FOOTBALL
2025, VOL. 9, NO. 2, 163–171
https://doi.org/10.1080/24733938.2024.2325135

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Understanding the role of gaze behaviour and coaching experience in the assessment of youth soccer teams

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ABSTRACT

This study aimed to explore the perceptual-cognitive characteristics of coaches as they assessed team performance in youth soccer. The primary focus was to investigate the alignment between coaches' subjective analyses of team behaviour and objective analyses, while also examining the relationship between coaches' gaze behaviour and their levels of coaching experience, particularly considering the potential differences that may exist among coaches with varying levels of experience. Sixty-five male and female adults with various soccer coaching experience (experienced, novice, other team sport experience, and non-team sport experience) watched five 4-minute videos and assessed team behaviour. These subjective evaluations were compared to objective data obtained from video analysis and GPS, which included measures of completed skills, spatiotemporal characteristics, and passing networks. The participants' fixation duration and frequency were measured for each video clip, and the area around the ball specifically. The study found no significant differences between groups regarding the number of times participants' subjective analysis aligned with the objective data ($p = 0.059$, $\eta^2 = 0.07$). However, coaches with soccer coaching experience demonstrated a higher fixation frequency and more revisits to the ball area when compared to participants without soccer experience ($p = <.001$, $\eta^2 = 0.09$). The current study offers a unique approach to uncovering soccer coaching expertise by combining objective and subjective evaluations of team performance. In summary, the study reveals that coaching experience did not impact how often coaches subjective analyses matched objective data. However, soccer coaches had distinctive gaze behaviour patterns where they revisited the area around the ball more often.

Highlights

- Coaches' perceptions of collective behaviour in soccer teams do not align with objective data, regardless of their level of coaching experience.
- Gaze behaviour differs between coaches with varying expertise levels.
- Both experienced and novice coaches visually revisit the area around the ball more often than non-coaches when assessing team performance.
- Quantitative data may provide an additional level of team analysis than subjective coach assessment alone.

ARTICLE HISTORY
Received 26 June 2023
Revised 11 February 2024
Accepted 22 February 2024

KEYWORDS
Expertise; gaze behaviour; performance analysis; skill; small-sided games

Introduction

Through the design of practice, coaches can exert influence and control over the development of individual and collective soccer skills (Cushion et al. 2006; Cushion 2010). To evaluate the effectiveness of practice sessions in achieving their intentions, coaches primarily use subjective observations (e.g. perceived quality of passes) alongside objective assessments (e.g. number of completed passes), when and if they are available (Kidman and Hanrahan 2010). Nevertheless, several researchers (e.g., Franks 1993; Laird and Waters 2008) mention the limitations of human observation within the coaching process. For example, due to the limitations of human attentional capacity, coaches' perceptions of training may be biased to a few key aspects of the game, potentially missing other key observations of practice behaviour. Augmenting or supplementing coaches' subjective observations with objective analyses to reduce any potential bias provides a perfect avenue for the growth in performance analysis seen over the last decade for training and performance (Carling 2008; Wright et al. 2012; Nosek et al. 2021).

This wealth of data available to coaches carries a risk of information overload, especially when the objective information collected by analysts is complex and not intuitively

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derived from gameplay observations by coaches. For example, many professional soccer organisations collect data on the geospatial locations of players during training sessions and games. These data are used to derive measures of physical output (distance covered, high-speed running efforts, etc.) as well as information on the size and shape of a team, and the role played by individual players within it. This is often referred to as team tactical behaviour (e.g. Goes et al. 2019) or collective behaviour (e.g. Fransen et al. 2022). These data can be very complex, often taking time, and task specific and analytical expertise to make sense of. The degree to which this information aligns with coaches' intuitive perceptions of team-tactical behaviour remains unknown. After all, minimising superfluous augmented feedback may assist with honing or reinforcing coaches' intuitive judgements based on intrinsic feedback mechanisms, which they readily rely on to make on-the-fly adjustments to team tactics during training sessions and competitive games. At the same time, coaches' subjective perceptions could benefit from additional data obtained through objective analyses, as is commonly the case in performance analysis departments of sporting organisations. Effectively complementing (and not replacing) coaches' judgements through objective analysis will likely also increase the uptake of information generated through performance analysis in coaching practices (Low et al. 2020). Hence, studying how objective performance analysis data can complement coaching judgements will provide insights into how performance analysis fits into coaching practices.

A coach's experience and expertise likely influences the accuracy of their subjective judgements (Costa et al. 2018), i.e. it can be assumed that the observations of better coaches are more likely to align with objective data than those of their less experienced counterparts. Previous research has already recognised the role of expertise in soccer coaching, highlighting differences in coaching behaviour and education whereby coaches with coaching-specific undergraduate degrees use different forms of questioning and are more self-aware (Stonebridge and Cushion 2018). Expertise also seems to influence the perceptual-cognitive capabilities of coaches. Previous work identifies that experienced tennis (Moreno, et al. 2006), gymnastics (Moreno et al. 2002), volleyball (Costa et al. 2018), and judo (Robertson et al. 2018) coaches utilise different visual search strategies than less experienced coaches (e.g. expert performers make fewer fixations but these are of longer duration, or have more/longer fixations on particular areas). Different visual search patterns in experienced coaches may arise because experts have more sports-specific knowledge, and therefore focus their attention on information sources they know to be more relevant to subsequent actions or decisions, which subsequently allows them to encode and retrieve information efficiently (Costa et al. 2018). Novice coaches, on the other hand, may more frequently attend to irrelevant information when making decisions, which could lead to more ineffective decision-making. Another aspect not previously considered in research is the shared tactical principles between sports (e.g., creating space in invasion games; Ward and Griggs 2011). While expert coaches may possess more sports-specific knowledge, it is plausible to consider that coaches from other sports may be able to identify attacking principles in similar situations (e.g., creating space in soccer vs. field hockey).

While information regarding the visual search behaviours and decision-making capabilities of soccer players is abundantly available (e.g. Williams and Davids 1998; Vaeyens et al. 2007; Roca et al. 2018), the same information is not readily available for coaches. The lack of research on the search strategies of coaches is problematic as the visual scene presented to the coach is dissimilar to the scene presented to the player (e.g., a coach often has a sideline or birds-eye perspective while the player is immersed within the scene). Athletes usually gather key information from their opponents' postural cues, along with teammates and opponents positioning to predict and respond to their movements (Williams and Davids 1998). The essence of this process lies in the immediate connection between what athletes perceive in their environment and their subsequent responses (i.e. perception-action coupling). On the other hand, coaches have a broader scope, observing the actions of multiple players in a larger area (i.e. collective team behaviour). They base their decisions on relative information, like the positioning of athletes in relation to one another (North et al. 2009). However, there's a notable delay between coaches observing the players and making decisions based on that observation (i.e. no perception-action coupling). It is, therefore, questionable if differences in visual behaviour between novice and expert players are generalisable to the gaze behaviours exhibited by novice and expert coaches.

An effective coach needs to be capable of accurately analysing collective behaviours, such as team-tactical patterns, in order to create effective strategical plans and decisions that are suitable for different match and training scenarios (Costa et al. 2018). The aim of the present study is to investigate the perceptual-cognitive characteristics of coaches when assessing team performance in youth soccer and explore the potential differences between coaches with different levels of experience (measured in years of coaching in their main sport). By examining the alignment between coaches' subjective, experiential analyses of team behaviour and objective data, as well as examining the relationship between coaches' gaze behaviour and their levels of coaching experience, this research seeks to enhance our understanding of how coaches evaluate and perceive collective team behaviours in the context of soccer. This work explores a novel paradigm, as to our knowledge, the objective and subjective analysis of collective behaviours have not been compared previously. Hence, given the research problem is relatively ill-defined and has not previously been studied in depth, no concrete hypothesis is proposed.

Methodology

Participants

Sixty-five participants were recruited through a convenience sample via the Belgian Football Federation and the local university (female = 24, male = 41). All participants completed a sporting participation history questionnaire (see supplementary material) to establish their level of coaching and other sports experience. Coaches with diverse levels of experience in soccer and other sports were incorporated to identify

Table 1. The participant's age, soccer playing experience and soccer coaching experience per analysis group.

Group	N (Female/Male)	Age (yrs ± SD)	Soccer playing experience (yrs ± SD)	Soccer coaching experience (yrs ± SD)	Other Sport Coaching Experience
Experienced Coaches	10 (0/10)	45.7 ± 5.6	22 ± 5.9	23 ± 4.6	
Novice Coaches	11 (0/11)	23.2 ± 1.2	13.9 ± 3.3	2.6 ± 2.6	
Team Sport Experience	16 (8/8)	20.9 ± 2.6	NA	NA	0.9 (0.8)
No team sport experience	28 (16/12)	20.1 ± 1.8	NA	NA	2.1 (1.8)

potential thresholds associated with varying levels of expertise during the data analysis. Participants were divided into four groups based on their responses to the questionnaire. Coaches currently working with nationally competitive and/or higher (e.g., professional/premiership) soccer teams and/or holding at least a UEFA A level qualification were placed into the 'experienced coaches' group. Coaches holding at least a UEFA C qualification and/or working with provincial or recreational teams were placed into the 'novice coaches' group. Participants with playing and coaching experience (provincial or recreational) in other team ball sports (e.g. handball, hockey, basketball) were placed into the 'team sports' group, and those with no experience in team ball sports, but who did have experience coaching or playing other sports (e.g. gymnastics, swimming, etc.), were placed into the 'non team sports' group. Participant characteristics are presented in Table 1. All participants provided written informed consent before completing the study and reported normal or corrected to normal vision. The study protocol was approved by the Ethics Committee of Ghent University Hospital and the Human Research Ethics Committee of the University of Newcastle.

Test film and apparatus

Video footage consisted of U15 players competing in 5 vs 5 small-sided soccer games (Aguiar et al. 2015). Coaches divided 20 players evenly into teams of five to ensure evenly matched teams and spread of positions. The games took place on the team's usual training surface with field dimensions set at 44 m by 34 m. Small, modified goals (1 m x 1.8 m) without goalkeepers and multiple balls were used to maintain play speed, and players were instructed to play as if it is a normal competitive match. Coaches were present but prohibited from giving instructions during SSG to prevent inconsistencies. All participants in the video provided written informed consent to be filmed for the purpose of this study. The footage was captured from the corner of the field at a height of approximately 3 m using an HD video camera (Legria HG40, Canon, Japan). This position allowed the complete viewing of the playing field.

For the registration of the eye movements, a Remote Eye tracking Device was used (RED, SMI, Berlin, Germany). Video Clips were displayed on a 55.88 cm (1680 × 1050 px) desktop monitor with the eye-tracking device mounted underneath. Participants were seated ≈70 cm from the screen on a seat 75 cm in height. This system recorded the right eye movements at a frequency of 120 Hz with an infrared-sensitive camera using pupil position and corneal reflection. The eye tracker was calibrated using a 5-point calibration grid. The calibration was repeated until the accuracy was better than 0.6° (Warlop et al. 2021). Validation was performed at the conclusion of the experiment to ensure the device remained accurate throughout the session. Visual search data recorded by the eye tracker were analysed offline using SMI BeGaze (ver. 3.4) software.

Participants were presented with a series of five video clips (each four minutes in length) in which the first clip remained the same for each participant to familiarise them with the SSG format and film; the following four were randomised for each participant to account for any order bias which may influence participants' search behaviours. At the beginning of the first video clip, participants were instructed to evaluate team performance as if they would for their own team. For two of the following videos, participants were instructed as follows: *'Please pay close attention to how effectively each team uses their space. Some related questions will follow'*. For the other two clips participants were instructed to *'Please pay close attention to how skilful each team is. Some related questions will follow'*. Each video had a standardised 3-2-1 countdown before playing. Participants were permitted a break of self-determined duration between video clips however, no participants required this.

After each clip, participants were asked two questions. In the clips where participants were asked to focus on the skillfulness of the players, participants were asked two separate questions using coaching language *'Which team had better technical skills?'* and *'Which team was better at sharing the ball between all players (by passing)?'*. After the clips where participants were asked to focus on the teams' use of space, they responded to, *'Which team took up the most space on the field?'*, and *'Which team used the wide areas of the field more?'*. Participants provided their answers by identifying the colour of the team (two teams per game) that correlated with their answer (i.e. pink, light blue, orange, dark blue [no vest]), or could select 'about the same'. Questions always corresponded to the same video, which remained the same for each participant. Participants were given the option to complete the test in English, or have it translated in their native language. Translations were provided by an experienced coach, proficient in both English and Dutch. The total time for data collection was ≈30 min. While the term 'technical skills' is in essence a misnomer, as technical skills rarely exist in the absence of tactics, scoping conversations with coaches revealed this is a commonly used term by coaches.

The experimental design was preceded by pilot tests with three soccer coaches of different levels. These coaches highlighted the difficulties of maintaining attention in videos much longer than four minutes, and across a long test period

consisting of multiple video clips. Given that some participants would have minimal experience watching games in this way, we chose the current design to maximise the feasibility to ensure optimal participant engagement.

Visual search

Using the SMI fixation detection algorithm, average fixation duration and fixation frequency (i.e. fixations per second) were calculated for each clip (SMI has not provided specific details about the algorithm at the present time). Within each clip, we identified the area around the ball as the Area of Interest (AOI) by manually mapping it on a frame-by-frame basis in the BeGaze software. To accommodate eye movements around the AOI, we expanded it to include both the ball and the player possessing it. The size of this AOI remained consistent across all video clips. We chose not to map other AOIs, such as individual players or the 'attacking/defending team,' due to potential overlap and close proximity, making it challenging to reliably distinguish between them. As such, measures of the average fixation duration (ms), relative dwell time to the ball area, and number of revisits were also calculated only for an area of interest containing the ball and player in possession of the ball. Relative dwell time on an AOI (i.e sum of fixations and saccades that hit the AOI) was calculated as a percentage of clip length. Tracking ratios in the present study exceeded 80% for all participants in each video clip (Warlop et al. 2021).

Data analysis

Responses to post-video questions

The answers given by the participants were compared to objective, quantitative data obtained from video and GPS analyses of the small-sided games. The quantitative data included measures of completed skill involvements (pass, touch, shot, dribble; measured by completion rate), passing network density (measured on a scale of 0–1), effective area (measured in meters squared), and team width (measured in meters), which were calculated following the methods described in O'Brien-Smith et al. (2022). These variables are often used to identify patterns and connections established between players (i.e. passing links) and indicate the spatial coverage by teams (i.e. length, width, area covered). Creating width (or using the width of the field) is a common principle of play amongst all types of invasion games (Ward and Griggs 2011). There was a difference of at least 30% in the quantitative data (e. g. completed skills, network variables, team effective area) obtained from the teams opposing teams in each of the games (Low et al. 2020; Fransen et al. 2022). These variables corresponded to the four questions asked of the participants (i.e. when asked about technical skills, data corresponded to completed skills, when asked about connectedness, data corresponded to network density, when asked about width, this corresponded to the teams lateral coverage, and when asked about total space, this corresponded to effective area of a team). To analyse the participants' answers, they were converted into a binary format: 1 indicated an answer that matched the quantitative data, while 0 indicated a mismatch. For instance, if one team had more completed skill involvements and the coach selected that team, then the data was coded as 1. The total number of correct answers, with a maximum of 8, was used for analysis. After responding to the pair of questions corresponding to each clip, participants were provided with the opportunity to comment on any notable points regarding the teams skills, connectedness or spatial distribution. This data was not included as there was only a 5% response rate from the participants. This question set and scoring system was used in the pilot testing, for which all three soccer coaches had no recommended changes.

Statistical analysis

First, a Kruskal-Wallis test was used to assess potential differences between participants with different levels of coaching experience. This non-parametric test was chosen due to the unequal variance of the groups and the ordinal nature of the dependent variable. To provide an estimate of the magnitude of the differences between groups, eta squared effect sizes were calculated with a 95% confidence interval ($CI_{95\%}$). Effect size thresholds were set as 0.01- < 0.06 (small effect), 0.06 - < 0.14 (moderate effect) and ≥ 0.14 (large effect Cohen 1988).

A multivariate analysis of variance (MANOVA) was then used to determine the relationship between coaching experience and different measures related to the coaches' gaze behaviours. The dependent variables analysed in these videos were (i) the average fixation duration, (ii) the fixation frequency, (iii) the relative dwell time on the AOI, (iv) the average fixation duration on the AOI, and (v) AOI revisits. The participant group (as categorised by coaching experience) was included as an independent variable. Data used in the MANOVA did not violate assumptions of normality and variances did not differ between compared groups. However, when checking the assumptions for subsequent ANOVA's used to examine post-hoc differences for individual dependent variables, two of the five variables had a non-normal distribution. Upon visual inspection, the novice coaches' fixation frequency and the non-team sport coaches' group AOI dwell time demonstrated a skewed distribution. However, given the fact that ANOVAs are reasonably robust against violations of normality (Knief and Forstmeier 2021), we opted to use ANOVA rather than to transform some of the dependent variables to facilitate the interpretation of the model's outputs. Bonferroni post-hoc corrections were applied to allow for multiple comparisons when further analysing expertise group differences. The visual search data of three participants in the experienced group were excluded as these data were collected using a different eye-tracking system. Partial eta squared effect sizes (η_p^2) were calculated and interpreted as follows: <0.01

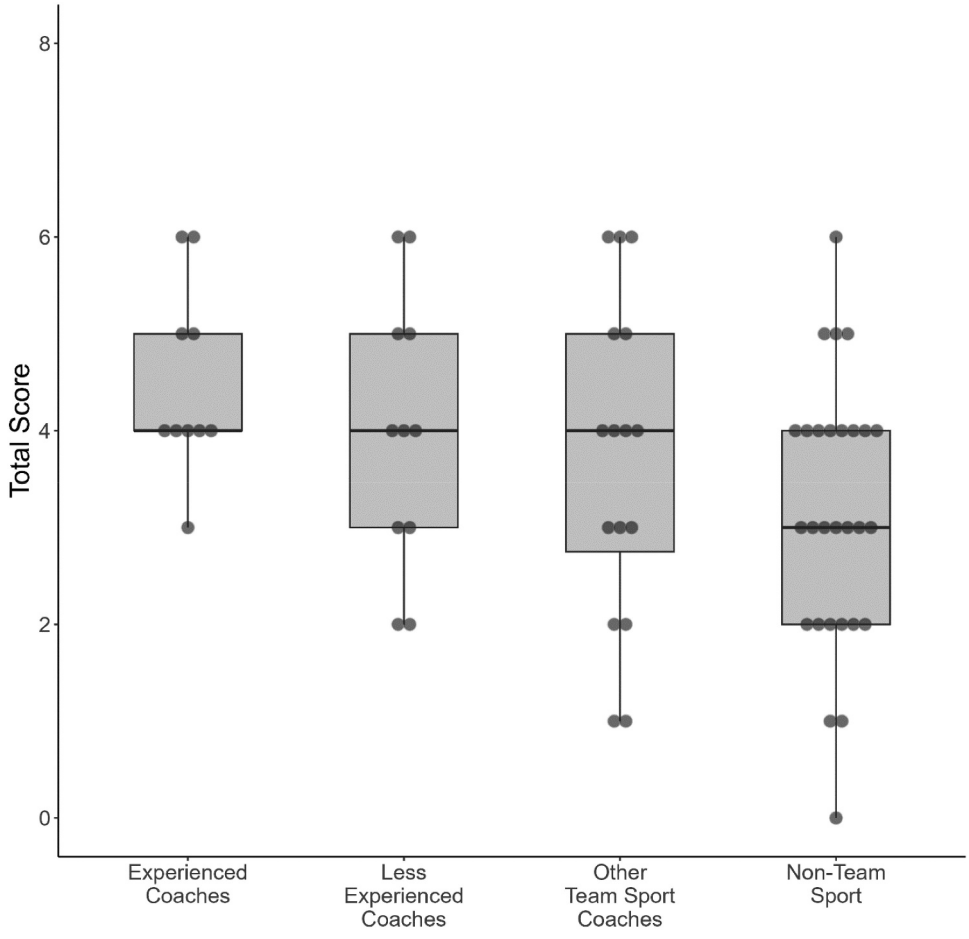

Figure 1. Box plot chart displaying the median and IQR of the total number of answers matching objective data for participants with different levels of soccer coaching experience.

(trivial), >0.01 (small), >0.06 (moderate) and > 0.14 (large) based on established thresholds (Cohen 1988). These thresholds were used to determine the magnitude of potential differences. Statistical analyses were performed using R (R Core Team 2021). Statistical significance was set at $p \leq .05$.

Results

The Krusak-Wallis test indicated no difference between the groups, $H_{(3)} = 6.38$, $p = .059$ in terms of the ranks on the number of times coaches matched the objective data. The effect size estimate (eta squared) was 0.07, indicating a moderate effect. The 95% confidence interval for the effect size ranged from trivial to large [–0.01, 0.27]. The number of matched answers provided by coaches is presented in Figure 1.

There was no difference in the matched answers between groups depending on the instruction focus (i.e. whether coaches were asked to evaluate a team's skillfulness or their use of space; $F_{(1,59)} = 0.072$, $p = 0.768$). Therefore, the responses to all questions were analysed collectively.

Post video questions

Visual search

The mean and standard deviation of average fixation duration, fixation frequency, AOI relative dwell time, AOI average fixation duration and AOI revisits are presented in Figure 2. There was no significant difference in the gaze behaviour between the videos depending on the focus of analysis (i.e., asking coaches to attend to a team's skillfulness vs use of space; $p = 0.961$). Therefore the visual search results of the clips with these instructions were analysed collectively. A MANOVA revealed a significant multivariate effect of coaching experience on gaze behaviour ($p = <.001$, $\eta_p^2 = 0.09$ [0.03, 0.12]). Subsequent ANOVAs showed a significant effect of coaching experience on fixation frequency ($p < .001$, $\eta_p^2 = 0.3$ [0.18, 0.52]) and AOI revisits ($p = 0.001$, $\eta_p^2 = 0.21$ [0.04, 3.4]). More specifically, experienced soccer coaches (3.1 ± 0.61) and novice soccer coaches (3.1 ± 0.79) had a higher fixation frequency than participants coaching other team sports (2.43 ± 0.4) and those with no team sport experience (2.68 ± 0.55). Additionally, participants with other team sport coaching experience had a lower fixation frequency than those without any team sport coaching experience ($p = 0.005$). Furthermore, experienced soccer coaches (126.74 ± 20.38) and novice soccer coaches (127.75 ± 26.04)

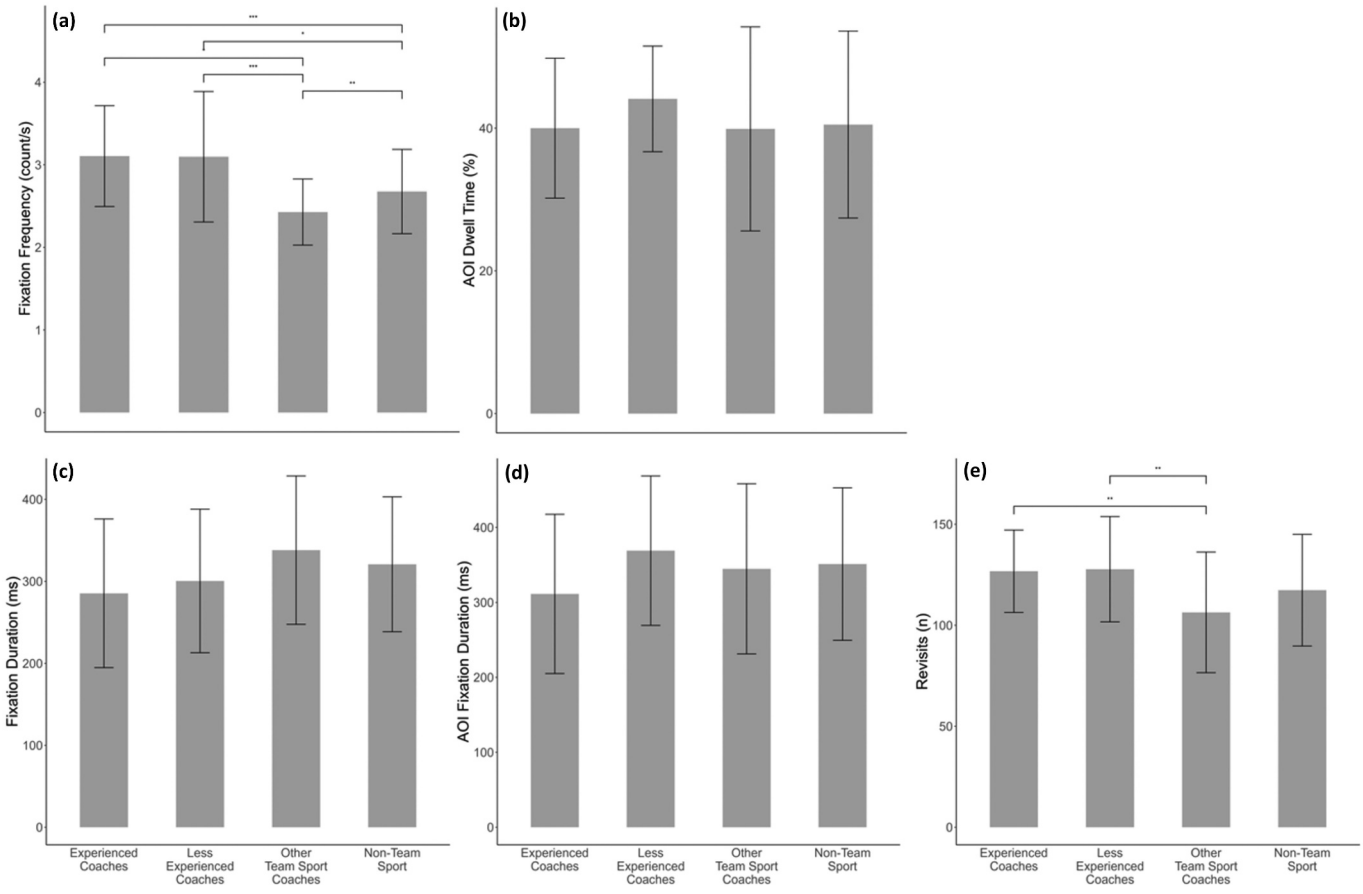

Figure 2. Mean and SD of fixation frequency (a), fixation duration (b), AOI dwell time (c), AOI fixation duration (d), and AOI revisits (e) for participants with different levels of coaching experience. All AOI statistics refer to the area around the ball. Bars indicate significant pairwise comparisons. * = p < .05, ** = p < .01, *** = p < .001.

had more revisits to the AOI than participants coaching other team sports (106.38 ± 29.85). No other between-group differences on the other dependent variables emerged from the statistical analyses.

Discussion

The study aimed to accomplish two goals: First, to compare coaches' perceptions of collective behaviour to objective data collected through analyses of factors such as team size and shape, passing networks, and skill execution, and examine any discrepancies among coaches with varying levels of experience. Second, to investigate coaches' gaze behaviour during small-sided game observation. The main findings of this study reveal that, regardless of experience, coaches' perceptions of collective behaviour do not match those observed objectively through spatiotemporal metrics, cooperative passing networks, and skill execution. Additionally, it appears that coaches with some level of soccer coaching experience possess different gaze behaviours when analysing collective behaviours than those with no experience.

In this study, coaches were to report on the skill involvement and collective behaviours of soccer teams observed in short video clips. The results revealed that the level of coaching experience was not associated with the number of answers coaches gave that matched the data. In other words, more experienced coaches did not have a higher percentage in which their subjective perceptions of skilfulness and tactical behaviour of the teams matched that of objective data obtained through video and GPS analysis than coaches with less or no soccer experience. While the p-value associated with this analysis was above the threshold set in this study for statistical significance, the analysis did reveal a moderate effect size ($\eta^2 = 0.7$). As a result, while no statistical differences in the frequency of response matching between subjective and objective data were observed, this effect size may warrant further exploration of the role played by expertise in the ability for coaches to recognise collective behaviours. It should also be noted that the moderate effect size has a wide 95% confidence interval ranging between no effect and a large effect [−0.01, 0.27], suggesting that more research, perhaps with a larger sample, is warranted to make more substantial inferences about how expertise in coaching is related to the ability to detect collective behaviours in-game.

Interestingly, at all experience levels, there was a large mismatch of subjective and objective data, with the median of both soccer coaching groups and coaches from other team sports being 4/8, and participants from individual sports only 3/10. While the methods used in this study are a novel way of assessing coaches' ability to detect cooperative collective behaviours during soccer gameplay, other research has confirmed a lack of differences in a volleyball-specific decision-making

task of volleyball coaches with different levels of experience when evaluating team performance (Costa et al. 2018). However, it is difficult to compare these considering the differences in sports and methodology. Several propositions have been made regarding expertise in general, and specifically coaching. It is commonly proposed that expertise is domain-specific and developed over a prolonged period often through personal experience (Nash and Collins 2006). However, it could be argued that truly understanding coaching expertise is intangible. Although coaches' actions may be characteristic of their knowledge and expertise, it may be challenging to articulate what they know and how that relates to different tactical and collective behaviours (Nash and Collins 2006). For this reason, if we wish to understand coaching expertise, it is important to do so holistically, assessing knowledge, and how that interacts with decision-making, practice design, and behaviour.

While the coaches' interpretations of skilled and tactical performance were not significantly different from those obtained through objective measures of collective behaviour, this study did reveal some differences in gaze behaviour between coaches of differing expertise levels when observing the video clips presented in this study. Both experienced and novice coaches had more fixations per second when compared to coaches with no soccer coaching experience. This particular scanning pattern is in line with literature examining the gaze behaviour of soccer players (Vitor de Assis et al. 2020), with soccer coaches tending to alternate their gaze between different areas of the display more frequently than other participants.

Concerning fixation location, while there were no differences in the relative duration spent looking at the area around the ball, experienced and novice coaches had more revisits to the area of interest surrounding the ball and the player in possession of the ball than those with no soccer experience. One explanation for this is that coaches used the player with the ball as an important anchoring point within the game, returning to that location after scanning the field for other relevant information, to update their information and make more accurate judgements, similar to experienced players (Vaeyens et al. 2007). In this instance, coaches could be scanning using a top-down mechanism of information detection. That is, they have expectations to what players and teams will do in certain situations. For example, a coach may expect the player with the ball to pass to a particular player; they divert their gaze to this expecting player and then back again to reaffirm if that is what the player with the ball will indeed do. Whereas participants with no soccer experience had no pre-conceived idea of the players actions and decisions and hence directed their gaze to irrelevant areas of the display. Research has reported similar findings in youth soccer players, suggesting that for players with more experience, the player with the ball seemed to be an important information source (Vaeyens et al. 2007). However, these studies' visual scenes and methodological approaches are quite different, limiting this comparison. Researchers have reported the use of 'visual pivots' in several sporting situations (see: Vater et al. 2020) and in defensive simulations in soccer (Williams and Davids 1998). It could be that there are no differences in fixation duration between the experienced and less experienced soccer coaches in the current investigation because both groups had substantial playing experience and understood the theory of the game.

The coaching skills captured in this study provide a limited view of the skills and behaviour required of coaches. Given that attempting to recognise data collected via quantitative and binary measures yielded no significant differences, and the process in which coaches assessed performance revealed no significant differences between the soccer coaches with different levels of experience, we must consider other factors that may characterise expert coaches. In this study, factors that stand out when examining the difference between these coaches are their age and years of coaching. Experienced coaches were older and had coached for more years. Accrued years of coaching experience likely contribute to an abundance of practical knowledge, an enhanced capacity to navigate intricate coaching scenarios, and a deeper understanding of the subtleties inherent in player performance (Partington et al. 2014). Some authors believe that the significance of experience, encompassing both coaching involvement and personal participation in sports is integral for coach development (Gilbert et al. 2006; Nash and Sproule 2009). This perspective aligns with the idea that coaches benefit significantly from a combination of practical coaching experience and direct engagement in sports competition. Furthermore, it emphasises the pivotal role of exposure to authentic learning environments in continuously honing coaches' knowledge and skills (Nash and Sproule 2009).

Small-sided games are one of the most popular training tools for coaches at all levels (Serra-Olivares et al. 2015). It could be argued that this is an area where expert coaches should excel. Some coaches in professional soccer seem to make positively impactful decisions in professional soccer at the perfect time (Nash and Collins 2006). We would likely see such intuitive decision-making in training scenarios as well, where expert coaches could adapt the training environment to meet their session outcomes best. Furthermore, it is appropriate to consider that the behaviour of a coach viewing and assessing SSG may not represent how they view and assess competitive soccer matches.

While this study provides some novel insights into coach expertise, several limitations should be considered. First, the data collection procedure occurred on a screen using an elevated perspective from the corner of the SSG. Most coaches will view SSG and match performance at ground level and can orient themselves around the game to get different perspectives (at training). Similarly, when reviewing performance, video footage is often presented from a bird's eye view at the centre of the field or directly above, typically captured by a drone. While the chosen perspective in this study served a practical purpose in enabling participants to observe all areas of the game, it may have influenced participant search patterns and interpretations of team performance. The screen size may have also limited the results, given the reduced size of the scene relative to real situations. Future research should attempt to explore gaze behaviour in a more representative environment (e.g. using eye-tracking glasses that allow freedom of movement). Likewise, by closely studying particular aspects of

individual players during the execution of specific skills, we can enhance our understanding of gaze behaviour and expertise. Investigating the criteria that expert coaches consider when evaluating individual players would provide valuable insights into talent identification and improve coaching interventions. Furthermore, we did not examine all measures of collective behaviour. It is unknown exactly what coaches can articulate, and what is observed more implicitly. It could be that the study design used did not allow us to accurately captures coaches perceptions of collective behaviour as they are represented by the quantitative data. Although the binary scoring method used in this study was practical, it might have constrained the identification of potential variations among coaches with varying levels of experience and individual perspectives. Finally, while a substantial amount of participants were recruited for this study, subsequent studies may want to increase the statistical power of their designs by limiting the scope of their investigation (e.g. experienced vs inexperienced coaches only) or by recruiting a greater number of participants in each experience group.

Conclusion

This study investigated assessments of collective team performance and gaze behaviour in coaches with different levels of experience. Results revealed that coaching experience had no significant association with whether or not coaches can interpret technical and tactical soccer performance in line with objective data when viewing footage of SSG. Furthermore, novice and experienced coaches had scanning behaviour that differed from participants with no soccer coaching experience, characterised by a higher fixation frequency and revisiting the area around the ball more often. These findings indicate that performance evaluations and gaze behaviour may not be strong indicators of coaching expertise and should be complemented by other factors such as tactical planning and training design and implementation when examining coaching expertise. Additionally, the use of quantitative data may reveal insights that coaches may not have been aware of through their own observations.

Acknowledgements

This research received no external funding. The authors would like to acknowledge all of the soccer clubs and participants for their contribution to the project.

Disclosure statement

No potential conflict of interest was reported by the author(s).

Funding

The author(s) reported there is no funding associated with the work featured in this article.

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Data availability statement

The participants of this study did not give written consent for their data to be shared publicly, so due to the sensitive nature of the research supporting data is not available.

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