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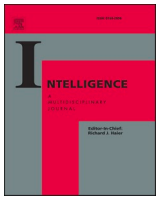

An investigation into differences in general intelligence and coaches' subjective assessment of players' decision-making skills across different playing positions in EPPP association football academies

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ABSTRACT

With developments in tactical complexity in association football (soccer) general intelligence and decision-making are becoming increasingly important attributes for players at all levels. However, an absence of evidence regarding general intelligence and decision-making across different positions within English Academy soccer indicates that it is unknown how specific intelligence in soccer needs to be for successful performance. This study aimed to 1) examine differences in general intelligence scores between different playing positions, 2) investigate differences in coach assessed decision-making ability between different playing positions and 3) assess differences between general intelligence test score ranks and decision-making ranks awarded by coaches to each player per position. One hundred and one participants, aged 16–18 years were recruited from eight clubs in the English Football League. Participants completed an established psychometric test of general intelligence and the lead development phase coach at each club ranked players' decision-making ability. There were 99 outfield players who participated: 37 defenders, 34 midfielders and 28 attackers. No difference was found in general intelligence scores between playing positions. However, a significant difference was found in decision-making ranks, with coaches determining attacker's decision-making to be lower than midfielders and defenders. Likewise, no difference was found between general intelligence and decision-making ranks for either defenders or midfielders, but a difference was observed between attackers' general intelligence and decision-making ranks. In conclusion, attacker's game intelligence appears to be underestimated by coaches. Consequently, utilisation of a psychometric test of general intelligence could enhance identification of talented players in Academy soccer.

1. Introduction

1.1. Role specificity in soccer

Since the Premier League's Elite Player Performance Plan (EPPP) was introduced association football (soccer) academies have been encouraged to include a diverse range of sports in player's training programmes (Taylor et al., 2024). Consequently, research has focused on the benefits of either early specification of a singular sport versus sport diversity, rather than differences across positions within a sport. Despite the encouragement of EPPP and observed research benefits of diversification - such as enhanced movement and problem-solving skills, reduced injury and burnout – many clubs continue to follow an early soccer specialisation programme (Taylor et al., 2024; Till & Baker, 2020). The limited research that the role general intelligence and decision-making have in sport specificity and diversity between positions obscures understanding of the optimal approach to develop talent.

Evidence supports the EPPP approach toward a 'broad transfer' of skills, whereby cognitive ability transfers to soccer from other invasion-sports (Causer & Ford, 2014). Neither did decision-making differ between positions in netball (Bruce et al., 2012). Further, no difference was observed in psychological skills for different positions in soccer (Beavan et al., 2022; Carnevale et al., 2022; Filgueiras et al., 2023; Jooste et al., 2014). However, no test of general intelligence was utilised in the psychological skills battery Jooste et al. (2014) utilised and the similarity could be attributed to player's traits being homogeneous at an elite level. Similarly, given the small-sided nature (3vs3) of the playing assessment Carnevale et al. (2022) utilised, it is harder to distinguish

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between positions and whether observations would transfer to an 11-a-side match as all players are either an attacker (in-possession) or defender (out-of-possession). Therefore, playing positions within the sample become homogenous, leading the researchers to suggest that all players should develop all physical and cognitive aspects of soccer regardless of position (Carnevale et al., 2022). Likewise, variance in cognitive performance could not be attributed to playing position and development of cognitive processes were not influenced by specific playing positions (Beavan et al., 2022). Exposure to a diverse range of playing positions increases development opportunities and ability to adapt to different positions at a later date (Lovell et al., 2018). However, Lovell, et al.'s, study investigated soccer development programmes in Australian academic institutions, which are not linked to professional clubs. This differs from the English EPPP where player's training programmes are aimed at developing professional players. Therefore, further research is required to determine if cognitive factors such as general intelligence and decision-making affect successful diversification within soccer.

1.2. General intelligence in soccer

The use of general intelligence tests in the talent identification process could be essential to a soccer club's understanding, projection and ability to shape an individual player's performance (Ones et al., 2012). General intelligence is the overarching cognitive factor responsible for repeated success across a range of different tests (Haier, 2017). It is positively correlated with learned skills, acquired knowledge and considered a more accurate predictor of performance across complex job roles than specific ability scores (Ones et al., 2012). However, most research on general intelligence pertains to non-sporting contexts and is lacking in soccer, which inhibits practitioners from utilising general intelligence as a tool for club's and player's benefit.

Utilising general intelligence testing within talent identification could identify players more able to attain required sport-specific knowledge with training and apply the correct sport-specific skills to situations. Furthermore, the relationship between general intelligence, information processing and decision-making in other sports (Burgoyne et al., 2016; De Pascalis & Varriale, 2012) suggests that players scoring higher on an intelligence test would display greater soccer intelligence. Similarly, a relationship has been observed between a recently created test of Athletic IQ and performance in American sports (Bowman et al., 2020; Bowman et al., 2021; Hogan et al., 2023). However, the test of Athletic IQ is based on four sub-factors of the Cattell-Horn-Carrol theory of general intelligence and has not been used in the field of soccer.

Much of the research undertaken on the relationship between general intelligence and sports performance has been in the National Football League (NFL). Previous observations questioned suitability of a general intelligence test in NFL due to no relationship between general intelligence and performance in the NFL (Lyons et al., 2009). However, these may be inaccurate once playing positions are controlled for, as higher levels of general intelligence predict success in more cognitively challenging positions (Pitts & Evans, 2018). Tests of Athletic IQ within the NFL found that success in specific playing positions requires different general intelligence sub-factors compared to alternative positions (Bowman et al., 2020). Consequently, it is probable that different playing positions require different sporting intelligence as per theories of multiple intelligences (Gardner & Moran, 2006). This contradicts the Cattell-Horn-Carroll theory of general intelligence - the basis for the Athletic IQ test. The specificity of intelligence in the NFL is influenced by the contrasting rules, roles, and requirements of each playing position – where some players might not touch the ball for the whole season. Therefore, despite the merits of this work the findings cannot be generalised to the more homogenous playing positions in soccer. For example, no relationship has been observed between executive functions and playing positions in soccer (Beavan et al., 2020). Executive functions are higher-level cognitive control processes that help keep an individual's goal-oriented thoughts and actions aligned by regulating thoughts and actions (Beavan et al., 2022; Sakamoto et al., 2018). Although general intelligence and executive functions are separate constructs (Friedman et al., 2006) a relationship has been observed between general intelligence and different executive functions (Nisbett et al., 2012; Verburgh et al., 2016). A substrate of general intelligence, fluid intelligence, is considered a higher order executive functions when observing the relationships between core and higher order executive functions within soccer (Filgueiras et al., 2023), without further elaboration of any relationship with soccer performance. Likewise, IQ (as an assessment of general intelligence) has been used as a control mechanism when assessing executive functions without interpretation and discussion – despite observations that the mean IQ of players in a Dutch Academy was lower than both players at an amateur club and non-players (Verburgh et al., 2016).

The relationship between executive functions and soccer performance has become a popular research topic with higher level players outperforming lower-level or non-players in tests of executive function performance (Beavan et al., 2020; Bonetti et al., 2025; Huijgen et al., 2015; Sakamoto et al., 2018; Verburgh et al., 2014; Vestberg et al., 2012; Vestberg et al., 2017; Vestberg et al., 2020). However, whilst studies compare participant's playing-level, interpretation of observations that control for playing position is limited. When playing position is used as a mediator between executive function performance and soccer performance statistics the utilised statistics were rudimentary, providing a narrow view of performance and favouring attacking players compared to midfielders and defenders (Filgueiras et al., 2023; Vestberg et al., 2020). Great variation is also observed between the independent test scores required for each executive function (Beavan et al., 2020) with contrasting results observed between the same executive function; e. g. Filgueiras et al. (2023) did not observe differences between higher order executive functions, whereas Vestberg et al. (2012) and Huijgen et al. (2015) did; Scharfen and Memmert (2021), Filgueiras et al. (2023), and Bonetti et al. (2025) found working-memory important for soccer or related to game intelligence, whereas Verburgh et al. (2014), Huijgen et al. (2015) and Vestberg et al. (2020) did not. Consequently, lacking the positive manifold observed in general intelligence. Therefore, despite being affordable, simple to administer to players and with high internal validity, it is unclear whether executive function tests allow complex cognitive processes to be quantified within the context of soccer performance due to poor ecological validity (Ali, 2011). Furthermore, executive functions have not been observed to be a good predictor of future potential, particularly within homogenous groups; rather prior relationships observed between executive functions and sports performance could be attributed to the threshold hypothesis, whereby no benefit is achieved beyond a certain level of executive function (Beavan et al., 2020). Talent identification in football is a complex process with a multitude of different variables, including a range of psychosocial factors, observed to influence a footballer's career progression (Gledhill et al., 2017). Thus, talent identification cannot currently be reduced to a single cognitive ability. Therefore, it should be determined whether general intelligence measures could accompany executive function tests, allowing clubs to accurately assess players' cognitive skills.

Without investigation it is unknown if general intelligence requirements could also vary between soccer positions. For example, attackers in advanced areas of the field are surrounded by opponents who limit the time they have on the ball, which requires fast processing speed. Consequently, the relationship observed between processing speed and general intelligence (Frischkorn et al., 2019) suggests greater intelligence could be required where decision-making needs to be quicker. However, Frischkorn, et al's observations are from general psychometric tests, which require application to soccer specific contexts to determine whether these observations apply to soccer specific decision-making.

1.3. Decision-making across different playing positions

Elite soccer players have exceptional cognitive abilities including decision-making (Ali, 2011; Bonetti et al., 2025). Indeed, the importance of higher-level executive functions to successful decision-making in soccer has been corroborated across investigations of executive functions (Filgueiras et al., 2023; Verburgh et al., 2014; Vestberg et al., 2017). Information-processing is the most common perspective of decision-making in sport, which is considered the ability to process external stimuli and select the best response (McGuikan et al., 2018). Decision-making is the component within intellect that distinguishes whether players reach an elite level and greater performance levels (Hogan et al., 2023); albeit in basketball rather than soccer. The stimuli rich nature of soccer can lead to cognitive overload; therefore, information-processing was observed to be more important than perceptual skills when making quicker, more successful decisions (Cardoso et al., 2021). Furthermore, participants with better response time were also able to provide more convergent explanations for decisions (Cardoso et al., 2021). As decision-making skills in soccer are related to other invasion-based sports (Causer & Ford, 2014), decision-making in soccer could utilise either no-thought, fast-thought or slow-thought processes at different situations during a match, as observed in rugby (Ashford et al., 2021b). However, the relationship between the invasion-based sports Causer and Ford (2014) observed was not specified, rather participants were split into three groups of 'soccer', 'invasion-sports' and 'other sports' causing ambiguity on how generic decision-making skills are. Furthermore, inter-positional relationships within the soccer group were not investigated; an important consideration given the different psychological demands between defenders, midfielders and attackers during performance (Najah & Rejeb, 2015). Different decision-making skills could be required as defenders work more to assess opponent's actions, whereas attackers initiate action in less space requiring more creativity (Duarte et al., 2012; Vestberg et al., 2012). Therefore, information-processing appears to differ between different areas of the pitch.

To aid attackers' processing-speed and reduce cognitive load when under time-duress decision-making would be made by a fast-thought system, rather than a slow-thought system (Kahneman, 2011). Consequently, elite performers have been found to utilise heuristic processes to generate quicker and more accurate decisions than less skilled soccer players (Basevitch et al., 2019; Klatt et al., 2019) with better perceptual-cognitive processes linked to better fast-thought decisions (Cardoso et al., 2021). However, these studies did not investigate whether differences are observed between playing positions. There are times in a match when time is so limited that players make decisions with no-thought; they just respond to what they see (Ashford et al., 2021a). Similarly, research on perceptual-cognitive ability in soccer has observed that decision-making is sport specific, with experts outperforming novices (Romeas & Faubert, 2015; Williams, 2000; Williams et al., 2008). Furthermore, perceptual-cognitive ability was also found to be position specific, with defenders outperforming attackers in anticipation of both an opponent's and a teammate's proceeding action (Williams et al., 2008). Defenders do not have time to think about what an opponent is going to do, rather they have to respond instantly. Although utilisation of no-thought, fast-thought or slow-thought decisions can be dependent on different situations, it is not known if the differences in decision-making processes leads to differences in required decision-making ability. Likewise, it is not known if that affects a coach's ability to accurately assess each position.

1.4. Coach's subjective player assessments

Due to difficulty in measuring cognitive soccer performance it has been suggested that potentially one of the better predictors of soccer talent could be via expert opinion (Ali, 2011). The lack of uniformity in measures and observations of executive functions add to the suggestion that predicting successful soccer performance cannot be based on executive function tests alone (Sakamoto et al., 2018). Coaches are experienced and qualified to perform their role with their assessment of talent being observed to offer both construct validity within academic research (Murr et al., 2021; O'Connor et al., 2016; Vestberg et al., 2020) and reliability (Jokuschies et al., 2017) - although great differentiation was present between what each coach assessed as talent. It has been observed that "the coach's eye" encapsulates intuitive, subjective judgements to make decisions, which are influenced by a coach's experience and holistic profile assessment of a player (Lath et al., 2021). Due to time constraints a fast and frugal heuristics approach to decision-making is purposeful within talent identification and development (Bar-Eli et al., 2024). Research has also found that coach's assessment of players' decision-making did not differ between coaches from two contrasting soccer-style cultures (Klatt et al., 2019). However, Klatt, et al., did not compare coach responses to player decisions. Therefore, it is not known whether coaches' assessment of decision-making is reliable across playing positions.

Soccer clubs could overlook talented players who fail the coach's eye test should inaccuracies occur between assessment of positions. The ambiguity of different underpinning tactical theories of attack versus defence combined with the dynamic multifaceted nature of soccer makes it a highly complex environment. Consequently, making it very difficult for coaches to subjectively assess players' decision-making or determine what talent is (Augestad et al., 2021; Baker et al., 2024; Fortin-Guichard et al., 2023), which leads to mistakes in talent identification and recruitment (Baker et al., 2019; Kelly et al., 2018). As a result, players have emerged after initially not being selected for talent development programmes (Fortin-Guichard et al., 2023). Although playing positions have not been separated to determine if more players were missed as talented from specific positions. Therefore, assessing for differences between positions will highlight whether alternative methods of assessment are required.

The first aim of the present study is to examine whether a difference in general intelligence exists between different playing positions in soccer. The second aim is to investigate whether there is a difference in coach assessment of decision-making ability between different playing positions in soccer. The third aim is to assess whether there is a difference between general intelligence test score ranks and decision-making ranks as awarded by coaches to each player per position.

2. Methods

2.1. Participants

Participants in this convenience sample were male, full-time youth team players ($n = 101$; aged between 16 and 18 years; mean playing experience 9.49 years) and coaches ($n = 8$) based at eight professional soccer academies. Five of the clubs held category 2 (of four) Elite Player Performance Plan (EPPP) status and three were classified as category 3. Player data was divided into four categories based on playing position: goalkeeper, defender, midfielder and attacker. For the purpose of this study only the outfield positions were analysed due to the small sample size of goalkeepers. Of the 99 remaining player participants: 37 were defenders; 34 were midfielders; and 28 were attackers. All coaches participating in the study held at minimum a UEFA B Coaching License. All participants provided written informed consent to take part. The study was approved by the University of Bolton Research Ethics Committee.

2.2. Procedures

Initially 61 of 93 category 1 to category 3 academies whose contact details were listed on their club website were contacted for involvement in the study. Each club expressing a willingness to participate ($n = 11$) was sent further details regarding the study. Three of the clubs that

initially expressed willingness to participate were unable to commit to completing testing by the assigned deadline. All players and coaches in participating clubs received information about the study prior to participation.

2.3. General intelligence

A shortened 20-min version of the Raven's Advanced Progressive Matrices Test was used as a test of general intelligence. This test was completed as a starter or plenary task within education sessions at participating soccer academy sites and was facilitated by the player participants' tutors. The group of player participants completed the test at the same time. Players had 20-min to answer 23 questions which increased in difficulty. The players were provided with the same instructions and had the opportunity to complete three practice questions that included explanations. Completed answer sheets were marked using the Raven's answer-key and verified by a second marker to confirm the correct grade was awarded. Responses range from 0 to 23, with higher scores indicating greater general intelligence.

2.4. Decision-making ability

The lead development phase coach at each participating club provided a subjective assessment of decision-making ability for each of the player participants. The best decision-maker was ranked first, the second-best decision-maker was ranked second and so forth.

2.5. Measures

2.5.1. General intelligence

The Raven's Advanced Progressive Matrices (APM) Test is a non-verbal test requiring participants to identify a missing pattern from determining the rule for each question. It is acknowledged as the best available measure of fluid intelligence; that is the ability to solve novel problems (Nisbett et al., 2012) that is seen on soccer fields. The test can be completed in groups settings with performance independent of education or culture (Haier, 2017). A shorter version of the test replicates time and decision-making requirements on a football pitch better than the traditional, untimed Raven's APM test. Validity and reliability between the short form test and traditional test have been demonstrated previously (De Dreu et al., 2012; Hamel & Schmittmann, 2006; Jaeggi et al., 2010) while a relationship has been observed between performance on a decision-making task and the Raven's short form test (Van Duijvenvoorde et al., 2012).

2.5.2. Decision-making ability

Utilisation of coaches providing subjective assessment of player decision-making ability is an established practice that has provided observed relationships with executive function results and statistical performance data (Scharfen & Memmert, 2021; Van Yperen, 2009; Vestberg et al., 2020). Coaches providing subjective assessments reduce time constraints that impact integration of larger, established instrument measures utilised within Physical Education, such as the Game Performance Assessment Instrument (GPAI) (Memmert & Harvey, 2008). Within the GPAI the assessor provides subjective opinion and an observational tally chart that requires training of preferably two individuals prior to coding of assessments to ensure observer reliability, which need to be checked to ensure interrater reliability. A time-consuming and impractical process for coaches alongside their daily routine. Rather, statistical data is collected by soccer clubs analysis departments that coaches can consult to support their subjective opinion, which guides ranking assessments. Furthermore, inter-rater reliability between subjective assessments of game intelligence in soccer has previously been observed (Scharfen & Memmert, 2021).

2.6. Analysis

To address study aim 1 a Shapiro-Wilk test was first performed to determine if there was normality of data for the general intelligence test scores for each position. Levene's test was then performed to assess whether the variances for each positions' score in the general intelligence test were equal. Data did not meet criteria for parametric testing. Therefore, a Kruskal-Wallis H test was performed to determine differences in general intelligence scores between playing positions. In order to address study aim 2, a Kruskal-Wallis H test was performed to determine differences in decision-making ability between playing positions. A Dunns post-hoc test with Bonferroni correction was applied to determine the difference between the groups. To address study aim 3 a Wilcoxon Signed-Rank test was performed determine differences for each playing position between the player's decision-making rank according to their coach and their rank in their squad based on their Raven's APM Short Form general intelligence test score.

3. Results

3.1. Study aim 1

Differences in general intelligence scores between different playing positions are presented in Table 1. Attackers recorded the highest mean general intelligence score for each position. The variances for each position's score in the general intelligence test were equal, $F(2,96) = 2.261$, $p = .110$. There was no significant difference between the scores achieved on the general intelligence test for playing positions as determined by the Kruskal-Wallis H test, $X^2\ (2) = 0.845$, $p = .655$.

3.2. Study aim 2

Scores for the coaches decision-making ranking when split for outfield positions are discrete, interval and were not normally distributed. There was a significant difference in the decision-making ranks awarded to defenders (mean sample rank 42.68), midfielders (41.97) and attackers (69.43) by coaches when the whole sample was combined (Kruskal-Wallis H Test $X^2\ (2)$ 17.96, $p = .000$; Table 1). A post-hoc test using Dunn's test with Bonferroni correction showed a significant difference in the decision-making rank between midfielders and attackers ($p = .001$) and between defenders and attackers ($p = .001$). The attackers ranked position across the whole sample for decision-making was significantly lower than defenders and midfielders. However, there was no significant difference between midfielders' and defenders' decision-making ranked position in the whole sample.

3.3. Study aim 3

There was no significant difference between the decision-making ranks awarded by coaches and the general intelligence test score rank per squad for defenders or midfielders (Table 2). A significant difference was observed between the coaches decision-making rank and the general intelligence test score rank for attackers (Table 2). Fig. 1 displays

Table 1
The average coaches ranking position and the average Raven's APM Short test score for defenders, midfielders and attackers (standard deviation; SD).

	Playing Position		
	Defender Mean (SD)	Midfielder Mean (SD)	Attacker Mean (SD)
	$n = 37$	$n = 34$	$n = 28$
Coaches decision-making mean ranking	5.89 (3.46)	5.88 (3.63)	9.61 (3.79)
Mean Raven's Test Score	7.51 (3.01)	7.24 (3.35)	7.61 (2.20)

Table 2
Wilcoxon Signed-Rank test to determine difference for each playing position between the players rank in terms of their DM by their coach and by the Raven's APM Short Form test.

		N	Z Statistic	Significance
Rank in Squad based on Raven's Test Score – Position in the Coach's DM Ranking	Defenders	37	−0.770	0.441
	Midfielders	34	−1.78	0.075
	Attackers	28	−2.81	0.005*

the direction of this difference. As a higher ranking equates to a lower number (e. g. top rank = 1), a negative total means that players are ranked higher in their squad for general intelligence score than they are ranked for decision-making, whereas a positive score indicates that players are ranked lower for general intelligence and higher for decision-making. A tied score means that players are ranked in the same position in their squad for both general intelligence and decision-making. For attackers there were 19 negative ranks where they are ranked higher for general intelligence, eight positive ranks where they are ranked higher for decision-making and one tied rank.

4. Discussion

The aim of this study was to determine whether general intelligence and decision-making ability among academy soccer players differs across playing positions. No difference was observed in general intelligence scores across playing positions. However, a difference was observed in coach assessed decision-making ranks between players. Coaches awarded lower ranks to attackers compared to midfielders and defenders. Furthermore, there was no statistical difference between general intelligence test score ranks and decision-making ranks awarded by coaches for defenders and midfielders, but a difference was observed with attackers' general intelligence ranked higher than their decision-making.

Results observed here corroborate and expand on previous literature that soccer intelligence requires a similar level of cognitive ability, rather than required cognitive ability varying across positions (Beavan et al., 2022; Carnevale et al., 2022; Filgueiras et al., 2023; Jooste et al., 2014). Each playing position might have differing cognitive demands, requiring different psychological skills and executive functions to control thought and behaviour (Najah & Rejeb, 2015; Williams et al., 2008), but the overarching general intelligence required for each to function effectively is the same. Therefore, general intelligence is not a differentiating factor in a players' ability to successfully play a specific position, nor for identifying playing position to predict future performance. The results of the present study are inconsistent with research on Athletic IQ and performance which found that different playing positions required differing general intelligence sub-factors (Bowman et al., 2020; Bowman et al., 2021). However, the differences between required sub-factors for each playing position could be due to the different positional demands of baseball and American football compared to soccer, which is more homogenous in nature and more in-line with observations of similar intellectual abilities required across basketball playing positions (Hogan et al., 2023).

The present study's observations offer guidance on the approach and type of coaching methods utilised by clubs. Players should be encouraged to rotate positions in training to broaden their skills and help the team (Bruce et al., 2012; Filgueiras et al., 2023), while participating in a player centred games-based training approach to enhance learning and develop generic cognitive soccer skills (Pill & Younie, 2015).

In contrast to observations of general intelligence test scores, a difference was observed in decision-making ranks provided by the coaches. No difference was observed between defender's and midfielder's decision-making, but attackers were ranked as weaker decision-makers. As defenders are in positions where mistakes are more costly (Williams et al., 2008) coaches could deem a need to select better decision-makers in these positions. Furthermore, defensive orientated players might appear to be better decision-makers due to making more no-thought decisions as they respond to opponent's movements (Williams et al., 2008), as well as having more time in possession to utilise slow-thought decisions. Likewise, better decision-makers could be selected in midfield as they perform the dual-roles of attack and defence. As with defenders, midfielder's mistakes can be deemed costly, while midfielders can also be afforded more time to make slow-thought decisions as there is less of an underload situation compared to attackers - particularly as they drop deep to receive the ball.

In contrast, attackers' mistakes are less costly. They are furthest from their own goal and largely outnumbered, so are less likely to be successful with their actions. Therefore, coaches could be willing to put poor decision-makers in attack, placing more emphasis on easier to assess physical traits, such as speed, rather than decision-making. However, the present study's results contradict previous observations

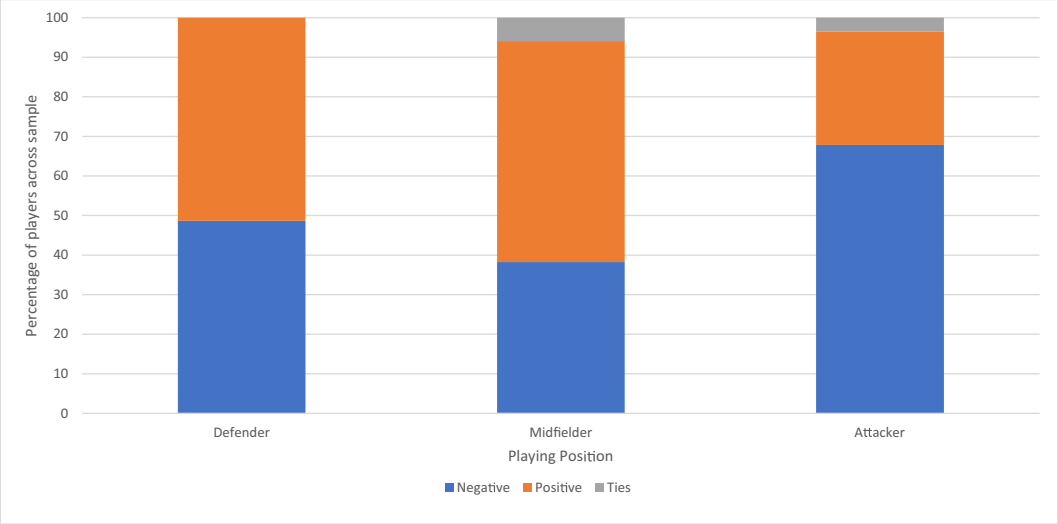

Fig. 1. 100 % Stacked Column displaying percentage of negative, tied and positive scores when the player's rank in their squad for their Raven's APM Short Form test is subtracted by their rank in their squad for decision-making. Positive scores indicate that the players were ranked lower with their general intelligence and higher with decision-making; negative scores indicate that players were ranked higher with general intelligence and lower with decision-making; tied scores mean that the players were ranked in the same position in their squad for general intelligence and decision-making.

that decision-making parity should be observed among players at a similar level (Hogan et al., 2023), which questions the accuracy of the decision-making assessment.

Attackers have to generate more precise decisions using a fast-thought system. Therefore, could be deemed to be less good at decision-making without a coach knowing a player's thought process for a decision. The reduced probability of an attack resulting in a successful outcome also affects coaches' intuitive assessments (Lath et al., 2021). Availability bias influences judgement, with more frequent occurrence's being more readily recalled (Kahneman, 2011). Therefore, attackers could be deemed as weaker decision-makers due to the lack of successful goalscoring chances being accessed easier in the coach's mind. Consequently, this leads to questions as to whether assessment of decision-making of attackers is accurate compared to the objective psychometric test of general intelligence.

The findings of this study suggest that the coach's assessment of defenders' and midfielders' decision-making, is not different to their general intelligence. However, assessment of an attacker's decision-making is below their general intelligence levels. Consequently, if the coaches' assessment of playing ability is accurate this suggests general intelligence could be more closely linked to decision-making ability for defenders and midfielders, compared to attackers.

The difference observed in this study between attacking player's general intelligence and their coach-assessed decision-making could also be attributed to differences in what the objective Raven's APM Short Form and the coaches subjectively measured. Attackers require greater creativity as they must initiate unpredictable situations to surprise defenders, whereas the other positions respond to what other players do (Duarte et al., 2012; Williams et al., 2008). Previous literature observed that differences between elite and sub-elite players (Huijgen et al., 2015; Vestberg et al., 2020) as well as between retained and rejected players (Sakamoto et al., 2018) are explained by higher-level executive functions, including creativity. Consequently, coaches could prioritise creativity in attackers. As the majority of participants in this sample were not yet first-team players, the attackers might have lacked the creativity required to be ranked as better decision-makers by their coach. Although the Raven's APM is a well-established psychometric test it does not capture creativity, thus creativity of attackers in the sample could not be determined from the data collected. As creativity is related to both general intelligence (Benedek et al., 2014) and decision-making (Forgionne & Newman, 2007) further investigation is required to determine whether the current method of assessment is fit for purpose.

Comparison of the present study's observations to comparable research is difficult due to a lack of research into the effect of general intelligence on soccer performance. However, consistent with the present study, it was discovered in the NFL that general intelligence scores did correlate with career success but did not correlate with higher draft position, which suggests that NFL organisations are undervaluing the role of intelligence when drafting a player (Pitts & Evans, 2018). If this is replicated in British soccer, clubs will be undervaluing an attacker's soccer intelligence. Consequently, the difference in decision-making rank for attackers brings in to question the assessment of decision-making via ranking by the coaches. Specifically, can coaches accurately evaluate decision-making of attackers if there is disparity between attackers' general intelligence and their on-field decision-making, which is a key component of their soccer intelligence (Vestberg et al., 2012). As positional demands of the game evolve with defensive players becoming more creative in their play when 'playing-out from the back' these issues could become relevant across all positions. Therefore, clubs should incorporate a general intelligence test within recruitment processes to integrate subjective and objective processes. Providing accurate assessment of soccer intelligence helps develop better player profiles that will reduce the risk of missing talent and inappropriately investing resources on player development. Identification of players with greater general intelligence increases probability of learning and development within the soccer club.

4.1. Strengths and limitations

This is the first study to investigate the difference between general intelligence across different positions in soccer. Utilising a validated measure of general intelligence builds on findings in American Football. However, the study is not without limitations. One potential explanation for why no difference was observed in general intelligence levels between different playing positions could be that the positions investigated are general positional units. Participants were separated in the analysis as a defender, midfielder or attacker rather than specific positions, for example right-winger or centre-forward. Due to the multitude of formations utilised in soccer it is difficult to specify exact player positions. However, the demands playing in a central versus wide area could affect cognitive processes and increase homogeneity of results. Due to requiring a 360° view of the field, players in a central role might require increased general intelligence for processing increased cognitive load, rather than a 180° view of a wide player. Therefore, it is recommended that further research compare wide versus central players with increased differentiation between positions potentially providing more accurate results.

Additionally, sample sizes across playing position were not equal. A smaller sample is evident for attackers relative to the other two groups, which could mean the observations for defenders and midfielders have greater strength. Future research could look to include equal sample sizes for each position. Furthermore, each participant specified their own playing position. This is reliant on players correctly identifying their position, which might be their preference, but not the position that their coach wants them to play, or that they have most experience in. Consequently, these limitations could bias results.

Moreover, the results do not discriminate if the players were successful at decision-making or not; just that they played that position and the coach determined them to be better or worse decision-makers compared to teammates. It is reliant on the fact that the clubs have selected players to play in the correct position for them and coaches to have accurately ranked each squad – a non-standardised, subjective process that itself is subject to bias. In time, further longitudinal research is warranted to investigate the success rates of key statistical data. Due to the area they play, attackers are heavily involved in creating goal-scoring chances; although not restricted to attackers the majority of key attacking statistics like Expected Assists (xA) and Key Passes occur in the attacking third, providing more opportunity to contribute creatively than midfielders and particularly defenders. Furthermore, incorporating more age groups and clubs from different countries will provide insight into how generalisable these observations are across the wider soccer playing population. Conducting research that investigates decision-making processes in terms of fast, slow or no-thought decisions compared to general intelligence, will also provide justification for thought processes and understanding as to whether they change depending on position.

Finally, the Raven's APM is a highly g-loaded test, yet as seen in this study does not capture a players full cognitive profile, e. g. creativity. A suggested explanation for why executive functions do not clearly or uniformly predict successful sports performance is that they do not align with sporting cognitive demands in competitive environments and so are unable to capture athletes full potential (Beavan et al., 2022). Likewise, the Raven's APM Short Form test is a recognised and widely used non-verbal reasoning measure of fluid intelligence, which focuses heavily on abstract pattern recognition and fluid reasoning, but not the full scope of general intelligence. In contrast, an intelligence test that samples a broader range of mental abilities could be used, e. g. - Weschler Adult Intelligence Scale (WAIS), the most widely-used test of intelligence (Haier, 2017). However, the WAIS is also not without limitations; it contains multiple subtests that takes over an hour to administer and is completed one-to-one rather than in group format.

Soccer is a complex sport, which makes it difficult to fully assess all component parts, with the choice of tests dependent on cost, time, participant numbers and research experience (Ali, 2011). Therefore, in future the Raven's APM test could be combined with D-KEFS Design Fluency Task or replicated with the WAIS to provide a more ecologically valid cognitive measure.

5. Conclusion

Results from a sample 101 professional soccer players found that general intelligence does not differ between playing positions. Therefore, general intelligence is not a factor that clubs should use to determine players for specific positions. However, the observation that coaches compare attackers' decision-making less-well to other playing positions, as well as to attackers' own general intelligence, suggests that coaches currently underestimate attackers' decision-making ability. Therefore, the clubs in the study are not accurately assessing academy attacker's talent. Correctly identifying each aspect of talent, in this case decision-making within soccer intelligence, would provide a gain that could lead to greater success for clubs employing a strategy that correctly assesses the soccer intelligence of players. Utilisation of an established psychometric test of general intelligence within a battery of psychological assessments will provide a further standardised, objective assessment tool to provide a more complete player profile.

CRediT authorship contribution statement

Scott Davies: Writing – review & editing, Writing – original draft, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Rob Noonan:** Writing – review & editing. **Colin Robertson:** Conceptualization. **Sean Sankey:** Writing – review & editing.

Declaration of competing interest

The authors report that there are no competing interests to declare.

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Data availability

The participants of this study inclusive of players, coaches and their clubs did not consent for their data to be shared publicly, so supporting data is not available.

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