Title: Functional adaptability in playing style: A key determinant of competitive football performance

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Functional adaptability in playing style: A key determinant of competitive football performance

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Abstract

**Purpose:** The present study examined the relationship between playing style adaptability and team match performance indicators throughout the season. Three playing style adaptability metrics were analysed, namely (1) *flexibility* (i.e., exhibiting a wide range of playing styles), (2) *reactivity* (i.e., adapting playing style based on opposition), and (3) *imposition* (i.e., executing pre-determined playing style regardless of opposition). **Methods:** Team playing styles were derived through a clustering analysis of 21,708 matches played in the top five male European leagues from 2014/15 to 2019/20. Spearman’s correlation was utilized to assess the association between the three playing style adaptability metrics and four team match performance indicators (e.g., shots taken in opposition penalty box; shots conceded in own penalty box; goals scored; goals conceded; and total wins). **Results:** Playing style flexibility was positively associated with both offensive and defensive match performance indicators and win frequency. Conversely, playing style reactivity and imposition were negatively associated with these team match performance indicators. **Conclusions:** Our results suggest that the capacity to exhibit a wide range of playing styles throughout a season is associated with greater team performance. Furthermore, it is possible that high performing teams are capable of functionally switching between playing style reactivity and imposition, depending on match dynamics.

Keywords: behavioural variability, football, playing style, adaptability, flexibility, performance analysis
Introduction

In competitive football, teams have to rapidly and continuously adapt their collective tactical behaviours to successfully respond to constantly evolving contextual constraints, such as opposition tactics, match score, match location, or game time remaining (Gómez et al., 2018; Lago, 2009; Lago-Ballesteros et al., 2012). This continuous adaptation of collective tactical behaviour occurs throughout each of the approximately 120 sequences of possession in each match (Tenga et al., 2010b), and also across the 34-38 game weeks in each season, as teams engage in a repetitive cycle of enforcing their own playing styles and initiating countermeasures to opposition tactics (Gómez et al., 2018; Hewitt et al., 2016). These collective tactical behaviours that emerge during matches are commonly described as team playing styles, or the “characteristic playing pattern demonstrated by a team during games ... regularly repeated in specific situational contexts” (Hewitt et al., 2016). This continuous adaptation of behaviour has spurred researchers to examine football teams through the lens of the ecological dynamics approach, wherein teams are viewed as complex collective systems that (re)organize their tactical behaviours through continuous interactions and exchanges of information with a performance environment (Vilar et al., 2012). In ecological dynamics, broadly describing a team by a single, summarized playing style (e.g., ‘counter-attacking’ or ‘high possession’) contributes little to understanding the characteristics of high performing teams. This is because it fails to account for the ongoing adaptations (or failures to adapt) and resulting match up of playing styles between the team and its opposition in each sequence (Gómez et al., 2018; Lago, 2009; Lago-Ballesteros et al., 2012). More precisely, match outcome (i.e., winning or losing the match), or key match performance indicators such as shots taken or goals scored, is likely more closely associated with a team’s ability to successfully exploit everchanging environmental and
task constraints of competition, in order to collectively produce a functional behavioural response (Seifert et al., 2016). The ability to generate and execute a wide range of functional, goal-directed behaviours in different contexts, has been identified as a hallmark of expert performance, and is widely referred to as *behavioural flexibility* (Johnson, 1961; Ranganathan et al., 2020), conceptually known as system *degeneracy* (Seifert et al., 2016).

Earlier work in ecological dynamics has also highlighted that behavioural responses of expert performers could be described as *interactive*, dynamically emerging as they functionally shift between an: (1) independence of, and, (2) dependence on perceived information from the environment (Davids et al., 2015). Under specific competitive performance dynamics, expert performers need to gravitate towards *behaviour reactivity*, in which certain preferred coordination tendencies are acted out in response to changes in specific task or environmental constraints. Conversely, expert performers may also demonstrate *behaviour imposition* in certain situations, characterized by the propensity for imposing a pre-determined set of tactical strategies that are independent of the unfolding situation. Crucially, the emergent behavioural interactions of an expert performer would neither be completely reactive, nor completely imposed, as intentional behaviour is guided by the detection of information to accomplish task goals. In football, however, perhaps due to limitations in player technical abilities or coaching philosophies, teams may choose to utilize an approach that predominantly imposes certain playing styles, regardless of actual match dynamics (Cordes et al., 2012).

In the present study, the team’s emergent collective behavioural responses (i.e., match actions performed) are considered to be reflective of the team’s playing style, surfacing from the adaptations (or failure to adapt) occurring throughout the match. The term playing style adaptability is, therefore, used to collectively describe the flexibility, reactivity, and imposition
of a team’s tactical behaviours in response to competitive match dynamics throughout the season. At present, existing work has reinforced the notion that functional playing style adaptability, displayed in response to game constraints emerging in each match (within-match adaptation), is critical in determining match performance and competition outcomes (Gómez et al., 2015; Lago-Ballesteros et al., 2012). To expand on this area of research, the current study examines playing style adaptability of teams throughout the course of the season (i.e., functional variability between matches) and its relationship with match performance indicators. Building on earlier work in this area (Duch et al., 2010; Grund, 2012), the current study hypothesizes that teams displaying greater playing style flexibility throughout the season would achieve more successful match performance indicators. Conversely, as expert performers can functionally adapt their behavioural responses towards an independence of, or dependence on the match situation, the current study also hypothesizes that a greater tendency for either tactical imposition or reactivity in playing styles would be negatively associated with match performance indicators. Therefore, the following research question is put forth: What is the association between team playing style adaptability (i.e., playing style flexibility, reactivity, and imposition) and match performance indicators within a competitive season?

**Method**

**Playing style clustering**

**Data source.** In order to derive the playing style exhibited by teams in each match, match event data were collected for all male professional competitive matches played in the English Premier League, French Ligue 1, German Bundesliga, Italian Serie A, and Spanish La Liga from the 2014/15 to 2019/20 seasons. These data were collected from the football data website Whoscored (www.whoscored.com), which primarily acquires data from Opta Sports. Prior
studies have been conducted to establish the reliability and validity of this dataset (Liu et al., 2013), and the dataset has been widely used in football performance analysis research (Kim et al., 2021; Nsolo et al., 2019, p. 2; Yi et al., 2019). The match actions dataset consisted of 31 actions classified into three categories that detail three fundamental phases of the game (Wade, 1998): attacking, defending, and possession (i.e., preparation or build up). A list and description of the match actions used in the clustering analysis of opposition playing styles are depicted in Appendix A.

Data pre-processing. As the variance of features in the match actions dataset were not homogeneous (e.g., number of ball touches compared to shots from fast break attacks), the features were scaled by removing the mean and scaling to the unit variance. This statistical procedure was conducted as machine learning estimators may not work well if each feature does not resemble standard normally distributed data (Pedregosa et al., 2011).

Clustering analysis

In general, the challenges of identifying team playing styles from match event data are twofold. First, there are no consensus guidelines that can be utilized to classify team playing styles. Second, because of the absence of quantifiable guidelines, the total number of team playing styles are not known. To address these challenges, a clustering analysis using unsupervised machine learning is proposed. This clustering approach reveals patterns in the dataset by clustering similar data points, resulting in different groups emerging. For this study, these emergent groups are taken to represent the different team playing styles.

The Expectation-Maximization Gaussian Mixture Model algorithm (GMM) was utilized for the clustering analysis. The GMM was selected based on its success with match event performance indicators in football - specifically in identifying goal scoring patterns (Wei et al.,
2013) and team formations (Bialkowski et al., 2014, 2016). For the GMM, number of clusters to be identified, \( k \), must be provided during model construction. However, as the total number of clusters (i.e., playing styles) are not known, a model selection process was necessary to derive a statistically ‘optimal’ \( k \). To this end, the clustering analysis was conducted 14 times, each time with a different \( k \) ranging from 2 to 15. The ‘optimal’ \( k \) was determined as the value that provides a best fit model, evaluated through the Akaike’s information criterion (AIC) and Bayesian information criterion (BIC) of each model iteration (Huang et al., 2017). In both criteria, a lower score indicates a better model fit.

**Playing style adaptability**

The emergent playing style clusters were used to determine the level of playing style flexibility, reactivity, and imposition for each team. To best constrain the influence of external and internal perturbations (e.g., changes in player roster or coaching staff), adaptability of team playing styles was examined within each season. The coefficient of unalikeability (COA), which provides a measure of variance for categorical variables (Kader & Perry, 2007), was utilized in the computation of playing style flexibility, reactivity, and imposition. The COA computation generates a coefficient on a scale from 0 (all observations are identical) to 1 (all observations are non-identical).

**Flexibility.** To determine team playing style flexibility, the COA of all playing styles utilized by the team throughout the season was computed (see Equation (1)). A COA value closer to 1 indicates that a team utilizes a larger range of playing styles throughout the season.

\[
\text{Flexibility} = \frac{\text{Total unalike pairs of playing styles}}{\text{Total pairs of playing styles}}
\]

(1)

In the computation of flexibility, the pairs of playing styles refer to the team’s playing style utilized compared to that of another week (e.g., Playing style of Week 1 vs Week 2; Playing
Reactivity. To determine team playing style reactivity, the COA of playing styles utilized against each opposition playing style throughout the season was computed. Building on earlier work in ecological dynamics (Hristovski, Davids, & Araújo, 2006; Hristovski, Davids, Araújo, et al., 2006), greater playing style reactivity was determined as a greater proficiency in realising a consistent movement response, based on affordances perceived (i.e., affordances perceived from opposition playing style). Therefore, in computing playing style reactivity, the derived COA value of the playing styles utilized, when facing a particular opposition playing style was inverted (i.e., \(1 – \text{Actual COA}\)). This was because greater playing style reactivity would designate a greater likelihood of generating a consistent playing style response when facing a specific opposition playing style. Therefore, a value closer to 1 is indicative of greater reactivity in playing styles utilized against each opposition playing style (i.e., more consistency in playing style responses when facing a particular playing style). The playing style reactivity values derived against different opposition playing styles was then weighted by the number of times the team faced that opposition playing style. Ultimately, overall team playing style reactivity was computed as the sum of all weighted playing style reactivity scores. Equation (2), where \(n\) encompasses the opposition playing styles faced, describes the computation of playing style reactivity.

\[
\text{Reactivity} = \sum_{i=1}^{n} \left( 1 - \frac{\text{Total unalike pairs of playing style vs style } i}{\text{Total pairs of playing style vs style } i} \right) \times \frac{\text{Times faced style } i}{\text{Total matches in season}}
\]

In the computation of reactivity, the pairs of playing styles refer to the team’s playing styles utilized when facing a certain opposition playing style (e.g., assuming playing style A was
faced in Weeks 1, 3, and 7: Playing style of Week 1 vs Week 3; Playing style of Week 1 vs Week 7).

**Imposition.** To determine the playing style imposition of teams, COA of playing styles faced by the team throughout the season when utilizing a particular playing style was calculated. Building on earlier work, a team with greater tendency to impose their playing style on a game would be more likely to execute predetermined behavioural responses, regardless of the unfolding match dynamics (Davids et al., 2015). Therefore, in the current study, this metric was derived from the variance of opposition playing styles faced by the team when they utilized a particular playing style. Consequently, a value closer to 1 was indicative of greater imposition in playing styles utilized against each opposition playing style (i.e., the team utilizes a predetermined playing style, even when facing a large variety of opposition playing styles). Each value for playing style imposition, when using a particular playing style, was then weighted by the number of times the team utilized that playing style. Ultimately, overall team playing style imposition was computed as the sum of all weighted playing style imposition values. Equation (3), where $n$ encompasses the opposition playing styles faced, describes the computation of playing style imposition.

$$\text{Imposition} = \sum_{i=1}^{n} \left( \frac{\text{Total unalike pairs of playing styles faced when using style } i}{\text{Total pairs of playing styles faced when using style } i} \right) \times \frac{\text{Times used style } i}{\text{Total matches in season}}$$

(3)

In the computation of imposition, the pairs of playing styles refer to the playing styles utilized by the opposition when the team utilized a certain playing style (e.g., assuming playing style A was used in Weeks 1, 3, and 7: Opposition playing style of Week 1 vs Week 3; Opposition playing style of Week 1 vs Week 7).

**Match performance indicators**
Four match events, derived from the same source as the input data for clustering, were utilized as match performance indicators. These match events were: (1) shots taken in the opposition penalty box; (2) shots conceded in their own penalty box; (3) goals scored; (4) goals conceded. These indicators were normalized by the number of matches played throughout the season, and were selected as they represent critical moments in competitive football matches, and are significant in determining match outcomes (Bartlett et al., 2012; Frencken et al., 2012; Ruiz-Ruiz et al., 2013; Sarmento et al., 2018). To avoid data dredging, these match performance indicators were excluded from the input dataset for playing style clustering (Smith & Ebrahim, 2002). Number of wins in each season was also utilized as a match performance indicator as it closely represents overall team success. Spearman’s correlation coefficient was utilized to compute the association between playing style flexibility, reactivity, imposition, and the four match performance indicators. Significant level was set at 0.05, and effect sizes of the correlation coefficient were as categorized as weak (<0.3), moderate (0.3-0.6), and strong (>0.6) (Lipsey & Wilson, 1993). Data pre-processing and the clustering analysis was conducted using the scikit-learn library (Version 0.24.2), while the computation of Spearman’s correlation coefficients was conducted using the SciPy-stats module (Version 1.6.3), all of which was conducted within the Python environment (Version 3.8).

Results

Playing style clusters

Through the playing style clustering model selection process, AIC and BIC values were lowest when the value of $k$ was 12 (see Figure 1). These findings suggest that clustering the match action profiles into twelve playing style clusters provides a model of best fit. The average
distribution of match actions performed by each playing style cluster, as well as a brief proposed
label of the playing style is depicted in Figure 2.

** Figure 1 somewhere near here **

** Figure 2 somewhere near here **

Playing style adaptability and match performance indicators

Playing style flexibility was found to have a small positive correlation with the number of
wins, \( r_s(586) = 0.28, p < .001 \); moderate positive correlations with the number of goals scored,
\( r_s(586) = 0.41, p < .001 \) and number of shots taken in the penalty box, \( r_s(586) = 0.43, p < .001 \);
Playing style flexibility was found to have small negative correlations with the number of goals
conceded, \( r_s(586) = -0.18, p < .001 \) and number of shots conceded in the penalty box, \( r_s(586) = -0.12, p < .01 \).

Imposition of playing style was found to have small negative correlations with the
number of wins, \( r_s(586) = -0.22, p < .001 \) and with number of goals scored, \( r_s(586) = -0.11, p < .01 \). Furthermore, playing style reactivity was found to have moderate positive correlations with
the number of goals conceded, \( r_s(586) = 0.3, p < .001 \) and number of shots conceded in the
penalty box, \( r_s(586) = 0.33, p < .001 \).

Playing style reactivity was found to have small negative correlations with the number of
wins, \( r_s(586) = -0.23, p < .001 \), and with the number of goals scored, \( r_s(586) = -0.35, p < .001 \);
and a moderate negative correlation with number of shots in the penalty box \( r_s(586) = -0.34, p < .001 \). Furthermore, imposition of playing style was found to have small positive correlations with
the number of goals conceded, \( r_s(586) = 0.16, p < .001 \) and number of shots conceded in the
penalty box, \( r_s(586) = 0.1, p < .05 \). The relationships between the measures of playing style
adaptability and match performance indicators are depicted in Figure 3.
Discussion

The aim of the current study sought to examine the relationship between within-season playing style adaptability and the achievement of key match performance indicators.

Playing style flexibility and match performance indicators

The results of the current study propose that teams with greater playing style flexibility, or ability to exhibit a wide range of playing styles throughout the season, tended to win more matches, and achieved greater offensive and defensive match performance indicators. This finding is consistent with findings reported in earlier work linking greater flexibility in team tactical behaviour with greater match performance indicators (Duch et al., 2010; Grund, 2012).

The positive relationship between playing style flexibility and offensive match performance indicators highlight the importance of being able to rapidly and voluntarily transition into a variety of player and ball movement patterns in the offensive phase. The capacity to quickly transition into different playing styles appropriately (i.e., most advantageous response to the demands of the game context) (Launder & Piltz, 2013), contributes significantly towards creating imbalance within the opposition. This capacity draws them out of their homeostatic defensive structures, leading to more goal scoring opportunities (Casal-Sanjurjo et al., 2021; Frencken et al., 2012; Hewitt et al., 2016; Tenga et al., 2010a). Moreover, greater flexibility in team playing style allows for more unpredictability in player and ball movements during the offensive sequence, which affords the attacking team more space and ultimately creates more goal-scoring opportunities (Schulze et al., 2021).

In the current study, greater playing style flexibility was also associated with fewer goals conceded and fewer shots allowed in the penalty box. This finding may suggest that highly...
flexible teams are able to better reorganize their defensive structures after losing the ball, which is significantly associated with a team’s chances of recovering the ball in the defensive phase (Casal-Sanjurjo et al., 2021). Specifically, highly flexible teams may be able to (re)organize their defensive structures more appropriately, in response to the offensive tactical strategy of the opposition (Tenga et al., 2010a, 2010b) or a match score situation (Santos et al., 2017), as they can adopt a wider range of playing styles. It is possible that highly flexible teams may be able to achieve greater defensive match performance indicators by deliberately transitioning into a playing style that constrains the attacking team, consequently forcing the opposition to play more predictably in the offensive phase (i.e., forcing opposition into the adoption of a playing style, involuntarily) (Stöckl et al., 2021). However, despite the significant association between playing style flexibility and match performance indicators highlighted in the current study, the effect sizes were small to moderate. Therefore, the highly dynamic, continuously changing nature of football should be duly recognized, and caution should be exercised so as not to overstate the role of playing style flexibility – as match performance is undoubtedly a culmination of numerous factors outside of playing styles.

From a practical perspective, teams that can display a wide range of playing styles are also harder to prepare for because of the uncertainty surrounding which styles they will opt for (and when) in a game. More specifically, when facing highly flexible teams, coaches must prepare their teams to face a wider range of potential playing styles, which limits the time they have in preparing the team to produce the optimal response when facing certain styles. However, despite the potential advantages of increased playing style flexibility highlighted earlier in this section, in practice, it may not be straightforward to improve the playing style flexibility of teams. In particular, teams must dedicate a significant amount of time towards the practice of
different styles, allowing for each player to understand the intricate nuances of each playing style and to recognize the potential emergent affordances that guide decision making (i.e., when to switch playing styles and which playing style to switch to).

**Playing style reactivity and match performance indicators**

Further than flexibility, the current study also examined the playing style reactivity of teams, or the team’s propensity to respond to tactical affordances in the competitive environment (Davids et al., 2015; Seifert et al., 2016). Indeed, earlier work has highlighted that a reactive playing style strategy is one that professional football teams undertake in actual competition, characterized by a focus on reacting to opposition behaviour, rather than opting to dictate or impose their own (James et al., 2002).

However, results of the current study suggest that, within a season, greater playing style reactivity may contribute negatively to match performance indicators. Specifically, teams who were content with merely reacting to opposition tactics, averaged a lower number of goals scored and shots taken in the opposition penalty box in each match. Teams that merely react to opposition behaviour may end up creating excessive predictability in their player and ball movement patterns, which limits their ability to create the necessary imbalance in the opposition and achieve successful offensive match performance indicators (Jones et al., 2004). More specifically, an excessive degree of team playing style reactivity in offense may be ineffective in shifting opposing teams out of their organized, homeostatic defensive structure, limiting creation of goal-scoring opportunities (Frencken et al., 2012; Tenga et al., 2010a).

Teams with greater playing style reactivity also conceded, on average, a greater number of goals and shots in their own penalty box in each match. It is possible that highly reactive teams, despite producing a more consistent playing style when facing certain opposition playing
styles, may be involuntarily trapped into behaving in unfavourable ways, thus being unable to
generate the optimal playing style given the match situation. The findings of the current study are
therefore in line with earlier work, which have highlighted that teams experience poorer match
performance indicators when they excessively react by altering their style of play (particularly in
recovering ball possession) to the task and environmental constraints that emerge during the
match (Vogelbein et al., 2014).

**Playing style imposition and match performance indicators**

The current study also examined the match performance indicators associated with
adopting a team tactical approach that primarily focuses on imposing a playing style.
Specifically, the measure of playing style imposition described the degree in which teams
displayed a predetermined playing style regardless of the opposition playing style encountered.
The results of the current study highlighted that greater imposition of playing styles was
negatively associated with offensive outcomes (fewer number of goals scored and shots in the
penalty box) and defensive outcomes (greater number of goals conceded and shots conceded in
the penalty box).

Findings of the current study are in contrast to earlier work, which have proposed that
successful teams demonstrate greater imposition of their playing style, and are less likely to
deviate from the premediated strategies that they have planned or worked on during preparation
(Hughes et al., 2019; Lago & Martin, 2007). Particularly, earlier work has proposed that greater
playing style imposition is crucial towards successfully achieving match performance indicators
in an environment with a large variety of ever-changing external perturbations (Orth et al.,
2018). It is important to note however, that earlier work advocating the merit of an imposing,
dictatorial playing style approach drew their conclusions based on the styles of possession that
teams displayed (i.e., ‘direct-play’ versus ‘possession-play’). Specifically, successful teams tended to impose their playing style through dictating a ‘possession-play’ playing style, that sought to dominate and maintain ball possession against opponents (Bloomfield et al., 2005; Hughes et al., 2019; Lago & Martín, 2007).

In the current study, a potential explanation for the significant association between playing style imposition and poor match performance indicators could be that weaker, less successful teams are forced to predominantly undertake a tactical strategy of utilizing an unchanging playing style regardless of opposition behaviour. For example, less successful teams generally have a lower number of attacking opportunities compared to top teams (Gollan et al., 2018), and may be forced towards predominantly utilizing a defensive-oriented playing style (Gollan et al., 2018). Greater propensity towards imposition in playing style responses potentially limits the exploratory tactical behaviours (i.e., trying out new player movement patterns) that players can voluntarily engage in during defensive phases, which potentially limits the development of their ability to perceive tactical shared affordances offered by the opposition during the match (Araújo & Davids, 2016; Seifert & Davids, 2012). To this end, the findings of the current study are in line with earlier work proposing that inability to, or longer delays in, transition when entering the defensive phase, is associated with a greater number of goals conceded (Frencken et al., 2012; Tenga et al., 2010a). Conversely, teams that transitioned more rapidly (i.e., defensive transition lasts 15 seconds or less) had a significantly greater chance of recovering the ball (Casal-Sanjurjo et al., 2021).

At the highest level of competitive sport, teams are constantly seeking to analyse opposition performance tendencies and predict their match strategies (Gómez et al., 2018; Hewitt et al., 2016). Considering this, a potential downside in excessively seeking to impose the playing
style of one’s own team is that it provides greater certainty for opposition teams to reliably predict how the team will behave, allowing opposing teams to develop appropriate countermeasures and prepare for them in training.

**Functional balance between playing style imposition and reactivity**

The findings of the current study present a novel contribution to existing research, especially in highlighting the significant influence of functional adaptability in playing styles on match performance indicators. In line with earlier work, results of the current study indeed corroborate that effective match performance indicators are a product of the performer being able to functionally shift between performance behaviour in imposing styles on, and reacting to, opponents (Davids et al., 2015). That is, results of the current study indicate that a rigid imposing or reactive approach are detrimental to match performance indicators. Particularly, the findings of the current study seem to indicate that, akin to how specific playing styles are more efficient in certain contexts, effectiveness in varying playing style is also largely dependent on emergent contextual constraints.

For example, high ranking teams may benefit from imposing a possession-dominant playing style when facing lower ranked opponents, as such strategies have been shown to lead to greater likelihood of success in key match performance indicators (Bloomfield et al., 2005; Fernandez-Navarro et al., 2019). In other contexts, such as when a large lead has been attained, imposing a counterattacking or direct style of play (instead of adapting to the opposition’s behavioural responses) has been associated with greater match performance indicators (Lago, 2009; Lago-Peñas & Dellal, 2010). Conversely, earlier work has highlighted that successful teams adapt their ball possession recovery strategies depending on the match context, such as when they are losing or tied with the opposition (Vogelbein et al., 2014). Given the diversity of
player roles and attributes that are unique to each player within the team, a certain degree of reactivity in team playing style may allow individuals in a team to perceive and use shared affordances, which in turn positively influences match performance indicators in competition (Silva et al., 2013).

**Limitations and future work**

Future research should consider examining the relationship between within-match playing style adaptability (i.e., playing style adaptability between ball possession sequences) and match performance indicators. To the best of our knowledge, such work has primarily been limited to single season or single league analyses (Tenga et al., 2010a, 2010b), perhaps due to the complexities of data collection and quantification of within-match playing styles (Sarmento et al., 2022). Given the positive association between team playing style flexibility and team match performance indicators highlighted in the current study, future work may consider expanding the concept of playing style flexibility to individual performance. More precisely, as proposed by earlier work (Carrilho et al., 2020), higher performing players, or those with more successful playing careers may be those that are able to demonstrate greater playing style flexibility.

Building on earlier work by Zhou et al., (2021), which have highlighted that the playing styles utilized by teams evolve over time (i.e., across different seasons), it is possible that the variability in playing style may also change over time. For example, it is possible that a flexible playing style approach may be more widely used by teams over time. Therefore, future research may consider investigating the seasonal effects on playing style variability, and to highlight if this influences the association between playing style variability and match performance indicators within the same season.

**Conclusion**
In conclusion, the present study proposes that functional adaptability in playing styles displayed are significantly associated with match performance indicators. The present study found that the ability of teams to flexibly vary their playing style throughout the season was positively associated with team performance. Specifically, teams that can generate a wider range of playing style responses throughout the season are able to achieve more successful offensive and defensive match performance indicators, and ultimately also win more matches.

From a practical perspective, our results suggest that coaches should prepare teams to generate a diverse set of playing style responses, as the speed and range of playing style transitions may induce less predictability in player and ball movement patterns, providing teams with a tactical advantage. The results also suggest that a predominantly imposing (independent of evolving match dynamics) or reactive (dependent or following evolving match dynamics) playing style approach is detrimental to performance. Alternatively, the capacity to functionally shift between imposing and reactive playing styles, depending on the emergent task and environmental constraints, may be associated with greater success in match performance indicators.


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<th>Indicator no.</th>
<th>Indicator Name (Full)</th>
<th>Description</th>
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</thead>
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<td>1</td>
<td>Ball touches</td>
<td>Collective number of on ball touches</td>
</tr>
<tr>
<td>2</td>
<td>Passes – Defensive Third</td>
<td>Passes in team’s defensive third</td>
</tr>
<tr>
<td>3</td>
<td>Passes – Attacking Third</td>
<td>Passes in team’s offensive third</td>
</tr>
<tr>
<td>4</td>
<td>Passes – Midfield Third</td>
<td>Passes in team’s midfield third</td>
</tr>
<tr>
<td>5</td>
<td>Passes – Forward</td>
<td>Passes in forward direction</td>
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<tr>
<td>6</td>
<td>Passes – Left</td>
<td>Passes in left direction</td>
</tr>
<tr>
<td>7</td>
<td>Passes – Right</td>
<td>Passes in right direction</td>
</tr>
<tr>
<td>8</td>
<td>Passes – Backwards</td>
<td>Passes in backwards direction</td>
</tr>
<tr>
<td>9</td>
<td>Passes – Through balls</td>
<td>Passes where defensive line was split</td>
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<tr>
<td>10</td>
<td>Passes – Key passes</td>
<td>Passes leading to shot attempt but no goal scored</td>
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<tr>
<td>11</td>
<td>Passes – Corner</td>
<td>Passes from corner kicks</td>
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<tr>
<td>12</td>
<td>Passes – Set pieces</td>
<td>Passes from set pieces</td>
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<tr>
<td>13</td>
<td>Successful dribbles</td>
<td>Dribbles where defender was beaten</td>
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<tr>
<td>14</td>
<td>Unsuccessful dribbles</td>
<td>Dribbles where defender won the ball</td>
</tr>
<tr>
<td>15</td>
<td>Crosses attempted</td>
<td>Crosses attempted</td>
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<td>16</td>
<td>Shots – 6-yard box</td>
<td>Shots within 6 yard box</td>
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<td>17</td>
<td>Shots – Blocked</td>
<td>Shots blocked by defender</td>
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<td>18</td>
<td>Shots – Fast break attack</td>
<td>Shots from fast break/counterattack</td>
</tr>
<tr>
<td>19</td>
<td>Shots – Off target</td>
<td>Shots off target</td>
</tr>
<tr>
<td>20</td>
<td>Shots – Open play</td>
<td>Shots from open play</td>
</tr>
<tr>
<td>21</td>
<td>Shots – Outside box</td>
<td>Shots from outside penalty box</td>
</tr>
<tr>
<td>22</td>
<td>Shots – Penalty box</td>
<td>Shots from inside penalty box</td>
</tr>
<tr>
<td>23</td>
<td>Shots – Set piece</td>
<td>Shots originating from set pieces</td>
</tr>
<tr>
<td>24</td>
<td>Shots – On target</td>
<td>Shots on target</td>
</tr>
<tr>
<td>25</td>
<td>Aerial duels won</td>
<td>Aerial duels won</td>
</tr>
<tr>
<td>26</td>
<td>Clearances</td>
<td>Ball clearances</td>
</tr>
<tr>
<td>27</td>
<td>Interceptions</td>
<td>Ball interceptions</td>
</tr>
<tr>
<td>28</td>
<td>Shots blocked in defence</td>
<td>Shots blocked in defence</td>
</tr>
<tr>
<td>29</td>
<td>Crosses blocked in defence</td>
<td>Crosses blocked in defence</td>
</tr>
<tr>
<td>30</td>
<td>Successful tackles</td>
<td>Successful tackles in defence</td>
</tr>
<tr>
<td>31</td>
<td>Unsuccessful tackles</td>
<td>Unsuccessful tackles in defence</td>
</tr>
</tbody>
</table>
Figure 1.

Akaike (AIC) and Bayesian Information Criterion (BIC) values in model selection for clustering opposition team playing styles

Note. Model selection process for clustering team playing styles with $k$ ranging from 2 to 15. Lower AIC and BIC values are indicative of best fit.
Figure 2

Description of playing style cluster and distribution of match actions performed on average.

Note. The values above represent frequencies of the match actions performed on average by teams in the playing style cluster, normalized by the minimum and maximum values achieved on average for that particular match action by all playing style clusters.
Figure 3.

Relationship between playing style adaptability and match performance indicators.
Declaration statements

The Authors declare that there is no conflict of interest