Paper : Game Analysis

Predicting Success in Penetration Between Defenders and Midfielders in Soccer: A Logistic Regression Approach

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This study aims to identify the key factors influencing the success of receiving the ball unmarked between the opponent's defenders (DFs, Unit 3) and midfielders (MFs, Unit 2), hereafter referred to as the "units", using logistic regression analysis. A total of 795 plays from 26 group stage matches of the 2018 FIFA World Cup were analyzed. Key factors examined included off-the-ball movement, timing of movement, defensive organization, and pass characteristics. The logistic regression model revealed that the probability of success was higher when there were no DFs in front at the start of movement, when off-the-ball movements such as overlap and pull-away were used, and when the pass arrival time was short. Conversely, starting the off-the-ball movement before the passer received the ball decreased the success rate. Furthermore, the presence of multiple players between the units increased the probability of success. The findings suggest that team coordination and precise timing of movement are essential for receiving the ball in free space between the units. Future studies should expand this analysis to other tournaments and use statistical methods capable of handling nonlinear data to enhance practical application.

Keywords: soccer, notation analysis, logistic regression, off-the-ball movement

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1. Introduction

In soccer, scoring goals directly influences the outcome of matches, and many studies have focused on this topic. For example, data from the FIFA World Cup tournaments between 2006 and 2014 indicate that, on average, one goal was scored for every 10 shots, with 60%−70% of goals coming from open play and 30%−40% from set pieces (Casal et al., 2015). In addition, >70% of goals are scored from shots taken inside the penalty area (PA), and shots from inside the PA have higher scoring rates than those from outside (Michailidis et al., 2013).

Studies have also analyzed the types of attacks that lead to goals. In the Norwegian professional league, 41% of attacks were counterattacks, whereas 59% were possession-based attacks. Of the goals scored, 52% came from counterattacks and 48% were from possession-based attacks (Tenga et al., 2010). Alves et al. (2019) found that in the group stages of the 2018 FIFA World Cup (hereafter "WC"), the winning teams had significantly higher ball possession rates than the losing teams (52.3% vs. 47.7%). Some studies have suggested that maintaining possession leads to goals and victories, in certain leagues and tournaments; however, no relationship has been observed between possession and match outcomes. Furthermore, factors such as whether the team is playing at home or the influence of elite teams can skew possession statistics (Collet, 2013), indicating the involvement of match conditions.

A key in match conditions is the area in which possession is maintained. Decisive passes leading to scoring opportunities often occur after crossing the halfway line (Cordón-Carmona et al., 2020), highlighting the importance of maintaining

possession in areas close to the opponent's goal. Two primary ways can help maintain possession near the opponent's goal: regaining the ball in that area or transporting the ball to that area. A study on the defensive strategy of regaining the ball near the opponent's goal (high pressing) (Low et al., 2021) highlighted the advantage of ending the opponent's attack early. However, the disadvantages include an increased risk of the opponent successfully passing through the frontline and the expansion of space for the opponent's forward players. Defensive compactness, where players stay close together, affects regaining possession (Forcher et al., 2022); however, maintaining compactness during high pressing is challenging because the offside rule is not applicable until the halfway line (Fradua et al., 2013).

Whether the defensive organization is intact or disorganized is a crucial factor in determining the effectiveness of various strategies, with the compactness and number of defenders (DFs) as the main criteria. Tenga et al. (2010) reported that counterattacks are more effective when the opposing defense is disorganized. When the attacking team regains possession in a high area, the opposing team needs time to reorganize their defense, potentially increasing the chances of scoring. However, this strategy also carries risks, such as the increased likelihood of conceding goals if passes are made through the expanded space between the defense and midfield (Low et al., 2021). Therefore, players must employ defensive strategies based on the relative strength of the opponent and game flow.

Regarding attacking plays that exploit the space between the opponent's defenders (DFs) (referred to as Unit 3; FIFA Training Centre, 2021a) and midfielders (MFs) (referred to as Unit 2; FIFA Training Centre, 2021a) (hereafter referred to as the "space between the units"). Suzuki et al. (2018) reported that attacks utilizing this space were more likely to lead to goals or scoring opportunities compared with attacks from the sides or those that do not involve passing through the space between the units. In addition, Suzuki et al. (2019) demonstrated that when an attacking player receives the ball in this space with no DF in front of them (i.e., in a "free" position), they are more likely to create scoring opportunities.

A key factor in creating a free position to receive the ball is players' movement without the ball (off-the-ball movement). Herold et al. (2022) stated that off-the-ball movement can reduce the pressure from the opponent's DFs when receiving the ball. Diagonal movements or changes in direction were reported to contribute to pressure reduction when receiving the ball (Cordón-Carmona, 2020). Furthermore, the off-the-ball movement of players not directly involved in the play can influence the positioning of the opponent's DFs (Teranishi et al., 2022), indicating that the movements of other players are also crucial for creating free positions. However, previous studies have not clarified how to create free players in the space between the units. Because the statistical methods used in these studies, such as chi-square and t-tests, only compare individual factors, they do not reveal the relationships between factors; thus, deriving practical insights for coaching is difficult.

In soccer research, to address the limitations of such simple comparative analyses, statistical methods that account for relationships between factors, such as structural equation modeling and logistic regression analysis, have been increasingly used, which can systematically infer causal relationships (Casal et al., 2015; Souza et al., 2019). Logistic regression allows for the construction of predictive models for binary data and enables the examination of the effect of various factors on the outcome through odds ratios. Thus, constructing predictive regression models using logistic regression and calculating the influence of each factor effectively identify the plays that help create free players in the space between the units.

Based on the above, this study aimed to identify the plays that are effective in creating free players in the space between the opponent's DFs and MFs using logistic regression analysis.

2. Methods

2.1. Sample

The sample consisted of 795 plays in which passes into the space between the units were successful during 26 group stage matches of the 2018 FIFA World Cup Russia. Matches without any dismissals were selected because dismissals could significantly alter the flow of the match and the nature of the plays, potentially compromising the consistency of the analysis. To ensure the accurate extraction of data from all measurement items, overhead footage that included all players on the field was selected. This allowed for precise and detailed play analysis,

forming the basis of our selection criteria (**Table 1**).

2.2. Measurement method

The matches broadcast via satellite were recorded and then analyzed during playback. Dartfish (version 10.19; Dartfish Japan Co., Ltd., Tokyo) , a video analysis software, was used for recording and measurement. Dartfish allows for pausing and slow-motion playback, enabling detailed analysis of each play. To ensure reproducibility, data collection followed a standardized procedure for all plays.

2.3. Definition of the Space Between the units

Following Suzuki et al. (2018), the space between the units was defined based on two defensive organization conditions:

(1) When the defensive organization is intact

A line was drawn parallel to the goal line from the furthest-back DF and if there were three or more DFs, including the furthest-back one, within 6 m of this

Table 1 Analyzed matches

2018 FIFA World Cup			Result
Argentina	vs	Iceland	1-1
Argentina	vs	Croatia	0-3
Iran	vs	Spain	0-1
Uruguay	vs	Saudi Arabia	1-0
Egypt	vs	Uruguay	0-1
Croatia	vs	Nigeria	2-0
Costa Rica	vs	Serbia	0-1
Sweden	vs	South Korea	1-0
Serbia	vs	Swizerland	1-2
Tunisia	vs	England	1-2
Denmark	vs	Australia	1-1
Germany	vs	Mexico	0-1
Nigeria	vs	Iceland	2-0
Brazil	vs	Costa Rica	2-0
Brazil	vs	Swizerland	1-1
France	vs	Australia	2-1
France	vs	Peru	1-0
Peru	vs	Denmark	0-1
Belguim	vs	Tunisia	5-2
Belguim	vs	Panama	3-0
Poland	vs	Senegal	1-2
Portugal	vs	Spain	3-3
Portugal	vs	Morocco	1-0
Morocco	vs	Iran	0-1
Russia	vs	Egypt	3-1
Russia	vs	Saudi Arabia	5-0

line, the defensive organization is considered intact. This definition was based on the recommendation that the ideal covering distance was between 4 and 6 m (Hughes, 1996) and the fact that most modern soccer teams place at least three DF in their back line.

Space between the units: The line parallel to the goal line from the furthest-back DF was defined as unit 3 line. Players within 6 meters of this line are considered DF. The player closest to the unit 3 line who is not within the 6-m range was taken as the basis for defining the unit 2 line. The space between the unit 3 line and the unit 2 line, along with the width of the PA, was defined as the space between the units (**Figure 1**).

(2) When the defensive organization is disorganized

A line was drawn parallel to the goal line from the furthest-back DF, and if there are only two or fewer DFs, including the furthest-back one, within 6 m of this line, the defensive organization was considered disorganized.

Space between the units: The furthest-back DF was taken as the unit 3 line. The third player closest to the furthest-back DF (counting the furthest-back DF as the first player) was included as part of the DFs. The fourth player closest to the furthest-back DF was used to define the unit 2 line. The space between the unit 3 line and the unit 2 line, along with the width of the PA, is defined as the space between the units (**Figure 2**).

2.4. Measurement items

The measurement items were determined by first extracting factors from previous studies (Suzuki et al., 2018; 2019) that were considered to influence the success of passes into the space between the units. Subsequently, three soccer coaching experts, who were actively involved in research and coaching, reviewed and added factors, and the measurement items were examined in detail. Finally, another two experts verified the measurement items to ensure their validity. Below is an explanation of each measurement item.

2.4.1. Success or failure of penetration into the space between the units

The defensive situation around the player penetrating the space between the units at the moment they touched the ball was recorded based on the number of DFs within a 5-m radius of the penetrating player. DFs within the triangular area formed by lines drawn from the ball to both goalposts were categorized as DFs in front (**Figure 4**).

The situation was classified into two outcomes:

(1) "Success": When the number of DFs in front was 0.

(2) "Failure": In any case other than (1).

2.4.2. Time until the pass reached the passer

The time from the start of the attack that led to the penetration into the space between the units until the passer (the player who made the pass to the penetrating player) first touched the ball was measured.

2.4.3. Time the passer held the ball

The time from when the passer first touched the ball until he/she made the pass to the player penetrating the space between the units was measured.

2.4.4. Passer's area

The area where the passer was located at the moment they made the pass was recorded. The

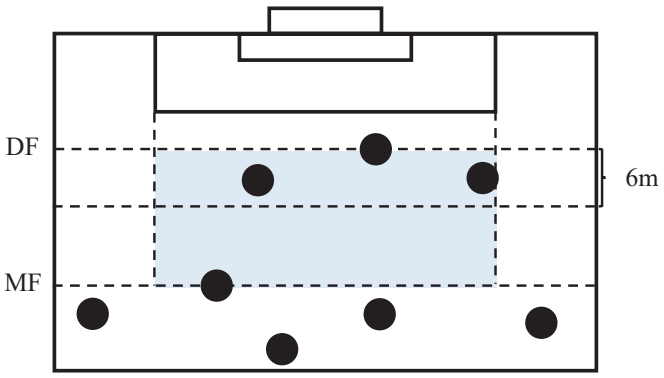

Figure 1 Space between the units: when the defensive organization is intact

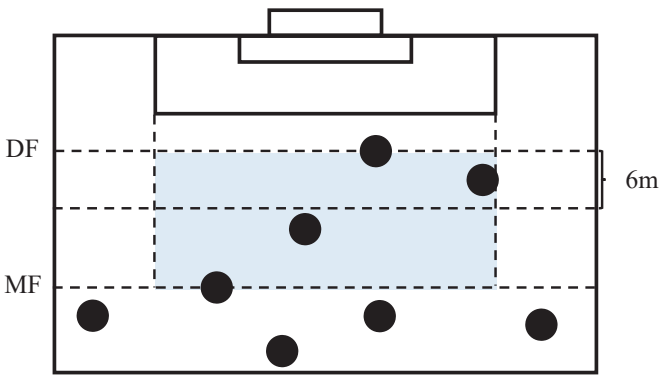

Figure 2 Space between the units: when the defensive organization is disorganized

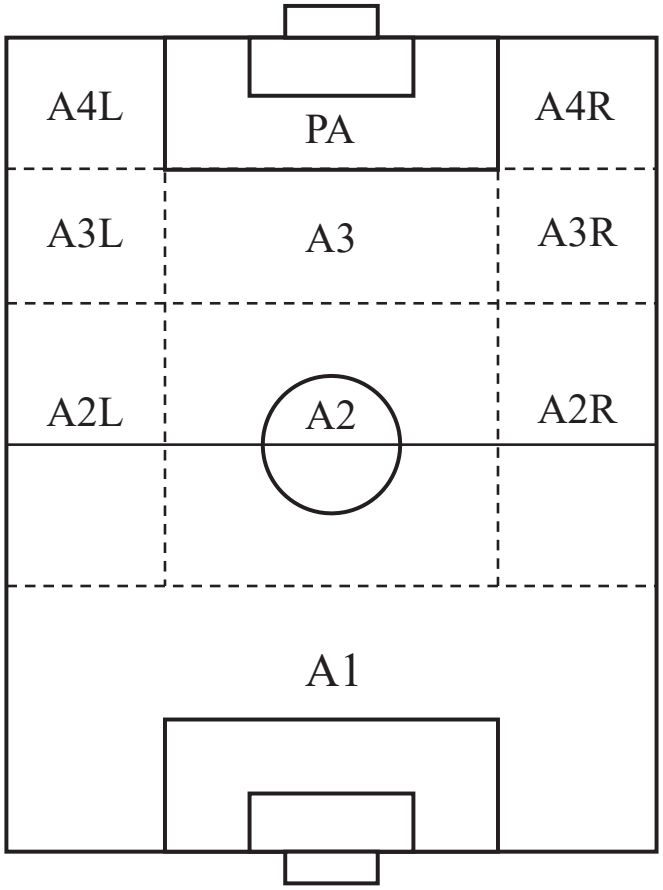

Figure 3 Area segmentation

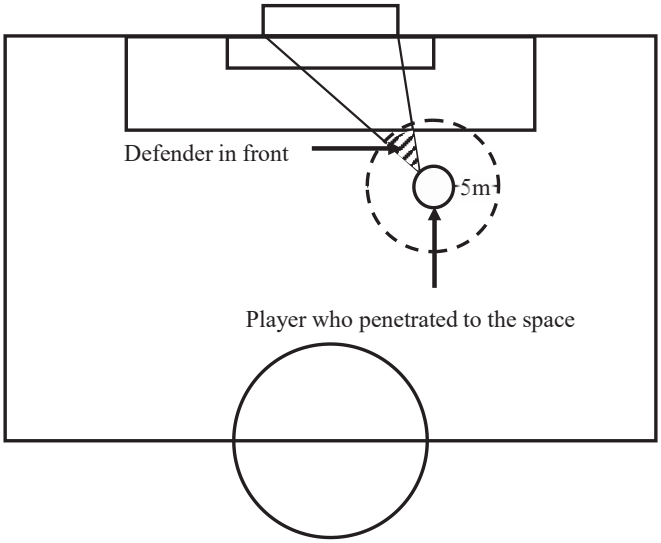

Figure 4 Defender in front

division of areas is shown in **Figure 3**.

2.4.5. Number of DFs in front

The defensive situation around the player penetrating the space between the units at the moment the passer made the pass, based on the position of DFs within 5 m of the passer, was recorded. DFs within the triangular area formed by lines drawn from the ball to both goalposts and within a 5-m radius of the passer were categorized into "0 DFs," "1 DF," or "≥2 DFs."

2.4.6. Number of DFs on the side or behind

DFs outside the triangular area formed by the lines drawn from the ball to both goalposts but within a 5-m radius of the passer were categorized into "0 DFs," "1 DF," or "≥2 DFs."

2.4.7. Type of pass

The type of pass made by the passer to the player penetrating the space between the units was categorized into two types:

(1) "Floating ball": When the pass to the penetrating player required them to control the ball above the waist height.
(2) "Ground pass": In any case other than (1).

2.4.8. Defensive organization

The defensive organization was categorized into two conditions based on Suzuki et al. (2018):

(1) "Defensive organization intact": When ≥DFs, including the furthest-back DF, were within 6 m of the line parallel to the goal line.
(2) "Defensive organization disorganized": When there were only ≥2 DFs, including the furthest-back DF, within 6 m of the line parallel to the goal line.

2.4.9. Defensive width

The distance between the two DFs (excluding the goalkeeper) positioned closest to each of the touchlines was measured at the moment the passer made the pass.

2.4.10. Defensive depth

The distance between the two DFs (excluding the goalkeeper), positioned closest to the attacking and defending goal lines, was measured at the moment the

passer made the pass.

2.4.11. Attacking width

The distance between the two attackers (excluding the goalkeeper) positioned closest to each of the touchlines was then measured at the moment the passer made the pass.

2.4.12. Attacking depth

The distance between the two attackers (excluding the goalkeeper), positioned closest to the attacking and defending goal lines, was also measured at the moment the passer made the pass.

2.4.13. Number of players between the units at the moment of the pass

The number of attacking players between the units at the moment the passer made the pass was categorized into "0 players," "1 player," or "≥2 players."

2.4.14. Number of players between the units at the moment the pass was received

The number of players between the units, positioned closer to the opponent's goal than the receiving player at the moment the ball was received, was categorized into "0 players," "1 player," or "≥2 players."

2.4.15. Pass penetration route

The route through which the pass into the space between the units passed was categorized as follows:

(1) "Front": If the pass penetrated the DF line.
(2) "Side": If the pass neither penetrated the defensive nor MF lines.
(3) "Back": If the pass penetrated the MF line.
(4) "Between the units": If the pass did not penetrate either the defensive or MF lines but was within the space between the units.

2.4.16. Penetration route of the player between the units

The route through which the player penetrating the space between the units moved, i.e., from the moment the passer first touched the ball to the moment the penetrating player received the pass, was categorized as follows:

(1) "Front": If the player penetrated the DF line.
(2) "Side": If the player did not penetrate the DF or MF lines.
(3) "Back": If the player penetrated the MF line.
(4) "Between the units": If the player was already in the space between the units before the pass was made.

2.4.17. Timing of movements

The timing of the off-the-ball movement made by the player penetrating the space between the units to receive the pass was categorized as follows:

(1) "Before the passer received the ball": if the movement started before the passer received the ball.
(2) "After the passer received the ball": if the movement started after the passer received the ball.
(3) "At the moment the passer made the pass": if the movement started at the moment the passer made the pass.
(4) "No movement": if no off-the-ball movement occurred.

2.4.18. Number of DFs in front at the start of movement

The number of DFs in front of the player penetrating the space between the units at the start of their off-the-ball movement was categorized as follows:

(1) "Yes": if there was at least one DF.
(2) "No": if there were no DFs.

2.4.19. Type of off-the-ball movement

The off-the-ball movement was categorized into six types:

(1) "Under lap": the player runs from behind and from inside to in front of the player on the ball or receiving the ball.
(2) "Overlap": the player runs from behind and from outside to in front of the player on the ball or receiving the ball.
(3) "Diagonal run": the player receives the ball while running diagonally from their starting position on the field (Cordón-Carmona et al., 2020).
(4) "Check": the player feints to receive the ball behind the opponent and then changes direction to receive it at their feet, or vice versa.
(5) "Pull-away": the player moves away from the closest DF to receive the ball behind the opponent's back line.
(6) "None": if none of the above movements were present.

2.4.20. Area where the pass was made

The area where the player penetrating the space between the units was located when the pass was made was noted.

2.4.21. Area where the receiving player was positioned

The area where the player penetrating the space between the units was positioned when they received the pass was recorded.

2.4.22. Distance moved after the pass was made

The distance the player penetrating the space between the units moved from the moment the passer made the pass until they received the ball was measured and recorded.

2.4.23. Pass distance

The distance between the passer's position when he/she made the pass and the player's position when he/she received the pass was measured and recorded.

2.4.24. Pass arrival time

The time from when the passer made the pass to when the player received the ball was measured and recorded.

2.4.25. Pass speed

The pass speed was calculated by dividing the pass distance by the pass arrival time.

2.5. Statistical analysis

2.5.1. Objectivity

Following the methodologies of Hirashima et al. (2014), Landis and Koch (1977), and Suzuki and Nishijima (2002), the objectivity of the measurement items was evaluated by examining the consistency between two analysts. Both analysts, who had soccer playing and coaching experience and engaged in soccer-related research, analyzed the same dataset consisting of 80 plays in which attacks penetrated the space between the units in three matches. Based on the results of these two analysts, kappa coefficients and intraclass correlation coefficients were calculated for each measurement item. Because the measurements required repeated pauses and replays of the videos, each analyst conducted their analysis independently.

2.5.2. Comparison between success and failure groups in penetrations between the units

The success and failure groups were compared in terms of penetration into the space between the units. For 14 categorical variables, chi-square tests were applied, and for 10 continuous variables, independent t-tests were used. For chi-square tests, residual analysis was conducted as a post hoc test. The significance level was set at 5%.

2.5.3. Examination of factors influencing success in the penetration between the units

To examine the key factors influencing the success or failure of penetration into the space between the units, a binary logistic regression analysis was performed using the success or failure of penetration as the dependent variable, and 14 categorical and 10 continuous variables as explanatory variables. Logistic regression analysis is suitable for constructing predictive models for binary data and is effective when the dependent variable is categorical. In this study, as the dependent variable was the binary outcome of successful or unsuccessful penetration, logistic regression was deemed appropriate. In addition, when selecting variables using logistic regression, "a significance level of 0.1–0.3 is recommended as a criterion for variable selection" (Uchida, 2011). Therefore, the significance level for variable selection was set at 10%. The coefficients for the selected factors were then calculated, and their effect was expressed using odds ratios. A regression equation was formulated to predict the probability of failure in penetration between the units. The fit of the regression model was evaluated using the Hosmer–Lemeshow goodness-of-fit test. A cutoff value of 0.5 was set for the predicted probability, and to assess the performance of the regression model, the sensitivity, specificity, positive-predictive value, negative-predictive value, and accuracy were calculated based on a confusion matrix. All statistical analyses were conducted using IBM SPSS Statistics version 28.

3. Results

3.1. Objectivity of the observed data

As shown in **Table 2**, the intraclass correlation and kappa coefficients for the analysis records ranged from 0.71 to 1.00 for all items, with an average of 0.87, indicating a high degree of agreement (**Table 2**).

Table 2 Objectivity of the observed

Measurement Items	kappa coefficients
Success or Failure of Penetration into the Space Between the Units	0.90
Passer's Area	0.86
Number of Defenders in Front	0.88
Number of Defenders on the Side or Behind	0.75
Type of Pass	0.89
Defensive Organization	0.84
Number of Players Between the Units at the Moment of the Pass	0.78
Number of Players Between the Units at the Moment the Pass Was Received	0.77
Pass Penetration Route	0.71
Penetration Route of the Player Between the Units	0.78
Timing of Movement	0.83
Number of Defenders in Front at the Start of Movement	0.87
Type of Off-the-Ball Movement	0.77
Area Where the Pass Was Made	0.91
Area Where the Receiving Player Was Positioned	0.94
Measurement Items	**the intra-class correlation coefficients**
Time Until the Pass Reached the Passer (Sec)	1.00
Time the Passer Held the Ball (Sec)	1.00
Defensive Width (m)	0.94
Defensive Depth (m)	0.96
Attacking Width (m)	0.95
Attacking Depth (m)	0.96
Distance Moved After the Pass Was Made (m)	0.78
Pass Distance (m)	0.83
Pass Arrival Time (Sec)	0.99
Pass Speed (m / Sec)	0.91

3.2. Situations of success and failure in penetration between the units

Table 3 shows the statistical values comparing successful and unsuccessful situations of penetration into the space between the units. In successful situations, the pass distance was significantly shorter ($t = 2.00$, $p < .05$; $t = 2.89$, $p < .05$). No significant differences were found in the time it took for the passer to receive the pass, time the passer held the ball, distance the receiver moved after the pass, time it took for the pass to reach the receiver, or speed of the pass ($t = -0.66$, $p = 0.51$; $t = 0.13$, $p = 0.90$; $t = 0.56$, $p = 0.58$; $t = 1.72$, $p = 0.08$; $t = 0.41$, $p = 0.68$, respectively). Regarding the timing of movement, the failure group had significantly higher values when the movement started "at the moment the passer made the pass," whereas the success group had significantly higher values when the movement started "before the passer received the ball" ($\chi = 14.38$, $p < .05$). The area from which the pass was made was significantly higher in the success group in the "A1," "A2," and "A2L" areas, whereas the failure group showed significantly higher values in the "PA" area ($\chi = 57.40$, $p < .05$). For the area where the ball was received, the failure group had significantly lower values in the "A2" area, whereas the success group had significantly lower values in the "PA" area ($\chi = 57.94$, $p < .05$). Regarding the number of defenders in front at the start of movement, the success group had significantly higher values for "yes", whereas the failure group had significantly higher values for "no" ($\chi = 225.54$, $p < .05$). For the penetration route of the player between the units, the failure group had significantly higher values for "between the units," whereas the success group had significantly higher values for "from behind" ($\chi = 54.40$, $p < .05$). Regarding the type of off-the-ball movement, the

failure group had significantly higher values for the "diagonal run," whereas the success group had significantly higher values for "overlap" (χ = 16.55, p <.05). For the area where the receiving player was positioned, the success group had significantly higher values in the "A2" area, whereas the failure group had significantly higher values in the "PA" area (χ = 57.94, p <.05). Regarding the number of players between the units at the moment the pass was received, the failure group had significantly higher values for "0 players," whereas the success group had significantly higher values for "2 players" (χ = 29.24, p <.05). For the number of players between the units at the moment of the pass, the failure group had significantly higher values for "0 players" (χ = 7.18, p <.05). Regarding the pass penetration route, the success group had significantly higher values for "side" (χ = 8.31, p <.05). No significant differences were found between the success and failure groups in terms of the passer's area, number of DFs in front or on the side and behind, type of pass, defensive organization (χ = 14.57, p = 0.10; χ = 0.53, p = 0.77; χ = 0.30, p = 0.86; χ = 1.21, p = 0.27; χ = 3.06, p = 0.08; χ = 2.01, p = 0.73, respectively).

3.3. Key factors influencing the success of penetration between the units and logistic regression equation

The results of the binary logistic regression analysis are shown in **Table 4**. The key factors that significantly influenced the success of penetration between the units were as follows:

- Presence of DFs in front at the start of movement,
- Timing of movement (before the passer received the ball),
- Type of off-the-ball movement (overlap and pull-away),
- Area where the ball was received,
- Time it took for the pass to reach the receiver,
- Number of players in front of the receiver in the space between the units at the time of the pass.

For example, the odds ratio for the presence of DFs in front at the start of movement was 0.12, indicating that the probability of success was 0.12 times lower when the DFs were in front than when they were not. Similarly, when the movement started before the passer received the ball, the probability of success was 0.68 times lower than when it did not. The odds ratio for the overlap movement was 3.27, and for pull-away movement, it was 3.32, indicating a significantly higher probability of success when these movements were used. The probability of success decreased as the ball was received closer to the goal (odds ratio = 0.68) and the longer it took for the pass to reach the receiver (odds ratio = 0.84). Finally, the odds ratio for the number of players in front of the receiver in the space between the units was 1.48, indicating that for each additional player, the probability of success increased by 1.48 times. The logistic regression equation to predict the probability of success using the above factors was as follows:

$$\text{logit}(P)=2.523-0.386x1-2.118x2+1.185x3+1.201x4-0.381x5-0.179x6+0.384x7$$

Where

- x_1 is the timing of movement (before the passer received the ball: yes (1) or no (0)),
- x_2 is the presence of DFs in front at the start of movement (yes (1) or no (0)),
- x_3 is the type of off-the-ball movement (overlap: yes (1) or no (0)),
- x_4 is the type of off-the-ball movement (pull-away: yes (1) or no (0)),
- x_5 is the area where the ball was received (1–7),
- x_6 is the pass arrival time (seconds),
- x_7 is the number of players in front of the receiver in the space between the units (number of players).

The fit of the logistic regression model was evaluated using the omnibus test for model coefficients and the Hosmer–Lemeshow goodness-of-fit test, which indicated the utility of the model for prediction and was well-fitted.

When the cutoff value for the predicted probability (P_1) was 0.5, the model had a sensitivity of 86.74%, specificity of 55.22%, positive-predictive value of 72.68%, negative-predictive value of 75.20%, and accuracy of 73.46% (**Table 5**).

4. Discussion

This study attempted to identify effective plays for receiving the ball freely in the space between the units using logistic regression analysis. The logistic regression analysis results indicated that the closer the receiving area was to the attacking team's side of the field, the higher the probability of success in evading marking. This indicates that when the defending team applies high pressure near the opponent's goal (frontline), the attacking

Table 3 Basic statistics

Measurement Items	Success (n=335)	Failure (n=469)		
	Mean		t	P
Time Until the Pass Reached the Passer (Sec)	1857.47	1488.55	-0.66	n.s.
Time the Passer Held the Ball (Sec)	996.02	1009.86	0.13	n.s.
Defensive Width (m)	29.19	29.96	1.67	n.s.
Defensive Depth (m)	26.45	27.15	1.27	n.s.
Attacking Width (m)	35.31	34.98	-0.52	n.s.
Attacking Depth (m)	28.81	28.77	-0.11	n.s.
Distance Moved After the Pass Was Made (m)	4.58	4.75	0.56	n.s.
Pass Distance (m)	27.31	30.31	2.89	<0.05
Pass Arrival Time (Sec)	1.33	1.43	1.72	n.s.
Pass Speed (m/Sec)	24.40	24.84	0.41	n.s.
			χ^2	P
Passer's Area			14.57	n.s.
A1	8.7%	16.4%		
A2	29.6%	26.6%		
A2L	5.3%	5.7%		
A2R	7.0%	6.3%		
A3	29.0%	27.5%		
A3L	5.3%	3.6%		
A3R	4.7%	6.0%		
A4L	1.9%	0.9%		
A4R	2.6%	2.7%		
PA	5.8%	4.5%		
Number of Defenders in Front			0.53	n.s.
0	61.4%	63.9%		
1	37.5%	35.2%		
2~	1.1%	0.9%		
Number of Defenders on the Side or Behind			0.30	n.s.
0	49.3%	49.3%		
1	39.4%	40.6%		
2~	11.3%	10.1%		
Type of Pass			1.21	n.s.
Ground Pass	70.8%	67.2%		
Floating Ball	29.2%	32.8%		
Defensive Organization			3.06	n.s.
Intact	19.6%	24.8%		
Disorganized	80.4%	75.2%		
Number of Players Between the units at the Moment of the Pass			7.18	<0.05
0	1.2%	3.7%		*
1	30.6%	31.6%		
2~	68.2%	64.8%		
Number of Players Between the units at the Moment the Pass Was Received			29.24	<0.05
0	36.5%	49.9%		*
1	31.1%	30.2%		
2~	32.4%	19.9%		*
Pass Penetration Route			8.31	<0.05
Front	1.8%	1.0%		
Side	23.9%	17.9%		*
Back	53.6%	57.2%		
Between the units	20.7%	23.8%		
Penetration Route of the Player Between the units			54.40	<0.05
Between the units	68.9%	79.1%		*
Side	6.8%	4.5%		
Front	0.9%	0.6%		
Back	23.5%	15.8%		*
Timing of Movement			14.38	<0.05
At the moment the passer made the pass	2.8%	7.2%		*
After the passer received the ball	20.0%	23.3%		
Before the passer received the ball	26.0%	18.2%		*
No movement	51.2%	51.3%		
Number of Defenders in Front at the Start of Movement			225.54	<0.05
Yes	54.3%	45.7%		*
No	92.0%	8.0%		*
Type of Off-the-Ball Movement			16.55	<0.05
Inner Lap	7.7%	5.1%		
Overlap	7.2%	2.4%		*
Diagonal Run	14.5%	20.9%		*
Check	0.9%	1.5%		
Pull Away	5.3%	4.5%		
None	64.4%	65.7%		
Area Where the Pass Was Made			57.40	<0.05
A1	3.8%	1.5%		*
A2	37.5%	22.4%		*
A2L	1.5%	0.0%		*
A2R	1.3%	0.3%		
A3	44.3%	49.9%		
A3L	0.9%	0.3%		
A3R	1.9%	2.4%		
A4L	0.2%	0.0%		
PA	8.5%	23.3%		*
Area Where the Receiving Player Was Positioned			57.94	<0.05
A1	1.9%	1.5%		
A2	35.6%	16.4%		*
A3	46.5%	46.3%		
PA	16.0%	35.8%		*

Table 4 Result of the logistic regression analysis

	B	Standard Deviation	Wald	P	Odds ratio
Timing of Movement: Before the passer received the ball	-0.386	0.203	3.615	0.057	0.68
Number of Defenders in Front at the Start of Movement	-2.118	0.221	91.703	<.001	0.12
Type of Off-the-Ball Movement: Overlap	1.185	0.434	7.457	0.006	3.27
Type of Off-the-Ball Movement: Pull Away	1.201	0.403	8.884	0.003	3.32
Area Where the Receiving Player Was Positioned	-0.381	0.058	42.575	<.001	0.68
Pass Arrival Time	-0.179	0.1	3.194	0.074	0.84
Number of Players Between the Units at the Moment of the Pass	0.384	0.087	19.221	<.001	1.47

Table 5 Regression model validity

		Predicted	
		Success	Failure
Observed	Success	187	152
	Failure	62	403
		Cut off = 0.5	

Sensitivity	86.74%
Specificity	55.22%
Positive predictive value	72.68%
Negative predictive value	75.20%
Accuracy	73.46%

team can easily evade marking between the units. When the defending team presses from the frontline, they find it difficult to maintain compact defense, as the offside rule does not apply until the halfway line (Fradua et al., 2013). In addition, when the defending team applies high pressure, the vertical compactness decreases, and the space between the units increases (Low et al., 2021). Consequently, it becomes more challenging for the defending team to cover the space between the units, potentially increasing the success rate of plays designed to evade marking in this space. Furthermore, decisive passes leading to goals or scoring opportunities often occur after crossing the halfway line (Cordón-Carmona et al., 2020). Accordingly, before the ball crosses the halfway line, the probability of receiving a decisive pass that directly leads to a goal is low, and even if the lines are penetrated, the defending team can highly likely recover before the ball approaches the goal. This situation appears to make it easier to penetrate the space between the units and create free spaces. This finding should not be interpreted as indicating that the ball should always be received far from the opponent's goal but that it becomes more challenging to be unmarked between the units as the ball approaches the opponent's goal.

The shorter the time for the pass to reach its destination, the higher the probability of success in evading marking between the units. To shorten the pass arrival time, the pass distance must be reduced or the pass speed must be increased. In soccer, short passes have a higher success rate than long passes (Cordón-Carmona, 2020). One reason for this is that short passes reach the intended player at a short time, providing the opposing team with fewer opportunities to intercept the ball. In addition, when the pass distance is long, increasing the pass speed can reduce the arrival time and decrease the chances of the opposing team intercepting the ball. Accordingly, the player making the pass into the space between the units can increase the probability of success by shortening the pass arrival time. Notably, neither pass distance nor pass speed was incorporated into the regression equation. This proposes that the pass arrival time is more crucial for receiving the ball unmarked between the units than the pass speed. When the pass distance is short, the pass arrival time will be shorter even without increasing the pass speed. Therefore, rather than simply increasing pass speed, calculating backward from the arrival time and adjusting the pass speed according to the distance are important.

The greater the number of players between the units (in front) when the receiver received the ball, the higher the success rate for evading marking between the units. This implies the significance of placing more players in the space between the units before the receiver receives the ball in successfully receiving the ball unmarked in this space. Placing multiple players in the space between the units makes it harder for the defending team's backline to press the ball. The top priority for the DFs is to prevent the opposing players from receiving the ball behind them. If they press a player attempting to receive the ball between the units, another player in the space may run into the open space behind them and receive the ball unmarked. Thus, the DFs must prioritize covering the space behind them before dealing with the player receiving the ball between the units. This dynamic affects the behavior of DFs when attacking players are positioned between the units. A study has also reported that off-the-ball movement influenced the actions of defending players (Teranishi et al., 2022). Therefore, players positioned in the space between the units beforehand may contribute to creating a space.

The probability of success was higher when there were no DFs in front at the start of movement than when there were DFs present. If a DF is in front of the player at the start of movement, it increases the likelihood that the movement is being observed by the opponent's defense. In addition, as the DF is within a 5-m radius, the distance is short, making it easier for the player to be marked once they receive the ball. Based on these factors, if the movement is observed by the opponent and the DF is close, it may become more difficult for the player to receive the ball without being marked. FIFA Training Center (2021b) emphasizes the importance of identifying and recording movements made to receive the ball in order to clarify why a player was able to receive it. Among these, movements such as **OUT TO IN**, described as *"a movement from outside the opposition team's shape to inside the opposition team's shape to receive the ball"* (FIFA Training Center, 2021b), are particularly effective for receiving the ball in the space between the units, especially when initiated in a situation where there are no defenders ahead of the player.

The probability of success was lower when the off-the-ball movement started before the passer received the ball than when the movement did not start. Herold et al. (2022) reported that off-the-ball movement reduces defensive pressure, increasing the success rate of passes. However, in this study, starting off-the-ball movement before the passer received the ball decreased the success rate. This indicates that depending on the timing and situation, the off-the-ball movement can negatively affect the success of the play. A possible reason is that early movement could signal the player's intention to receive the ball to the DF; however, further comparison with other situations is needed for a definitive explanation. This remains an area for future research.

Regarding the types of off-the-ball movement, both overlapping runs and pull-away movements increased the probability of success compared with when these movements were not used. This indicates that these movements are effective for receiving the ball unmarked between the units. Overlapping involves the receiver running past the passer from the outside. This allows the receiver to move while facing the direction of attack, making it easier to run into space that the opponent's DFs find difficult to mark. Therefore, receiving the ball through overlapping may increase the likelihood of receiving it unmarked. Pull-away involves receiving the ball while moving away from the opponent's DF. If this movement is successful, the player can receive the ball far from the DF. Although previous studies have reported the effectiveness of diagonal or vertical movements for successful passes (Cordón-Carmona et al., 2020), pull-away often involves diagonal movements. Because pull-away was not classified in previous studies and was included under diagonal movements, this result may not have appeared previously. However, diagonal movements that move away from the opponent may be effective.

4.1. Practical implications

The above findings have some implications for practical application. First, players responsible for receiving the ball should create space in advance and use off-the-ball movement to engage in tactical maneuvers before the passer receives the ball and then penetrate the space. Players responsible for passing into the space between the units should receive the ball in a position that shortens the distance to the space between the units. However, the ability to evade marking between the units may be a team skill. This is inferred from the idea that players positioned

in advance in the space between the units play a role in creating space. Therefore, evading marking solely through individual ability is difficult, and creating and penetrating space as a team is necessary. However, each player must understand whether their role is to create space or receive the ball between the units. Considering these points, team training or large group training may be essential for receiving the ball unmarked between the units.

4.2. Limitations of the study

First, this study has some methodological limitations. The data analyzed were limited to matches from the 2018 FIFA World Cup Russia. Therefore, whether the results can be applied to other tournaments or different categories (e.g., club level or other years of international tournaments) is unclear. To confirm whether similar results can be obtained in past tournaments or other categories, additional datasets must be verified. This will enhance the generalizability of the results. In particular, different tactics and player characteristics may influence the outcomes, making comparison with other data essential. To test the universality of the findings obtained in this study, future studies should collect and analyze data from other international tournaments and club matches.

In addition, logistic regression analysis was used for statistical processing. Logistic regression has advantages, such as constructing predictive equations for binary data and measuring the influence of items incorporated into the regression equation. However, it was weaker in handling nonlinear data, and only items with a direct influence were incorporated into the regression equation. In the future, using statistical methods such as Bayesian additive regression trees would be useful to compensate for the limitations of logistic regression and provide more comprehensive insights, leading to more practical research results.

5. Conclusion

This study attempted to identify effective plays for receiving the ball freely in the space between the units using logistic regression analysis. In conclusion, the key factors influencing the success or failure of plays that evade marking between the units were as follows: "presence of DFs in front at the start of movement," "timing of movement (before the passer receives the ball)," "type of off-the-ball movement (overlap)," "type of off-the-ball movement (pull-away)," "area where the ball was received," "pass arrival time," and "number of players in front of the receiver in the space between the units."

Based on the odds ratios, the closer the receiving area was to the team's side, the higher the success rate, and the shorter the pass arrival time, the higher the success rate. In addition, the probability of success decreased when the movement started before the passer received the ball, and the types of off-the-ball movements such as overlaps and pull-away movements were effective. Moreover, the player must not be marked by the opponent's DFs at the start of movement. Furthermore, placing more attacking players in the space between the units increased the probability of success in evading marking. Future investigations on the importance of each measurement item by employing statistical methods that can handle nonlinear data are necessary.

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