Paper : Game Analysis

Factor and Causal Structures of Counter Attack Skill in Soccer

Hiroki Matsuoka*, Kozue Ando* and Takahiko Nishijima*

*Faculty of Health and Sport Sciences, University of Tsukuba
1-1-1 Tennodai, Tsukuba, Ibaraki 305-8574 Japan
matsuoka.hiroki.ga@u.tsukuba.ac.jp

[Received February 2, 2022; Accepted June 28, 2022]

This study aimed to investigate the factor and causal structures of counter attack skills in soccer. The research procedure comprised three steps: 1) qualitative analysis to construct a qualitative causal structure and criterion-referenced measurement items of counter attack skills, 2) confirmatory factor analysis of counter attack skills in soccer, and 3) causal structure analysis using structural equation modelling (SEM). Counter attacks from 275 plays were collected through video files. Qualitative analysis led to the construction of the causal structure of counter attack skills in soccer, consisting of penetrative dribble, lay off, penetrative pass, pushing down the opponent's DFL (Defence line), and disrupting the opponent's defence, along with 17 criterion-referenced measurement items for these skills. The model fit indices of the confirmatory factor structure and the causal structure model were found to be acceptable, thus establishing the validity of the models. The causal structure model revealed significant causal relationships ($p < 0.05$) between penetrative dribble skill and pushing down the opponent's DFL skill (0.555), lay off skill and penetrative pass skill (0.588), and penetrative pass skill and disrupting the opponent's defence skill (0.653). The findings thus reveal the factor structure and the causal relationships among counter attack skills in soccer.

Keywords: football analytics, hand notational analysis, counter play, structural equation modelling

[Football Science Vol.19, 114-123, 2022]

1. Introduction

Game tactics in soccer has been developing remarkably. As such, soccer teams are playing at a faster pace in a more compact space. Hence, the number of goals from counter attacks has been increasing. Wallace and Norton (2014) analysed the finals of 12 World Cup tournaments that took place from 1966 to 2010. They found that in 44 years, ball speed increased by 15%, whereas the number of passes per minute increased by 35%. Barnes et al. (2014) analysed the 2006-2007 to 2012-2013 seasons of the English Premier League. They found that the sprint distance increased by approximately 35%, while the frequency of sprint increased by approximately 85% over seven years. In addition, the number of passes, successful passes, and short passes increased in the 2012-2013 season. The technical report of the 2018 World Cup in Russia claimed the following findings: (1) the average distance between the defensive line of the defensive team and the frontline players was 26 m, (2) the defensive formation was compact, and (3) majority of the goals were scored from fast attacking play (FIFA, 2018). The results of these studies indicate that soccer game tactics have developed, and that the number of counter attacks, which are attacks that happen before the preparation of the opposing team's defence, is increasing.

Soccer game performance was measured in game performance analysis research, which indicated the relationships between counter attacks and goal scoring or its opportunity. Tenga et al. (2010a, 2010b) analysed the relationship between offensive outcomes and tactical play in the 2004 Norwegian Professional League using binomial logistic regression analysis. They found that penetrative passes and counter attacks against an imbalanced defence were related to goal scoring (Tenga et al., 2010a) and scorebox entry (Tenga et al., 2010b). Lago-Ballesteros et al. (2012) analysed the relationship between scorebox penetration and tactical play in the Spanish First Division in 2009-2010 and found that long passes and counter attacks were effective against scorebox

penetration. Hughes and Lovell (2019) analysed the offensive transition of 29 final tournament matches in the Union of European Football Associations Champions league 2014-2015 and reported that 20 m runs (≥ 20 m), dribbles, and long passes (> 25 m) immediately after ball gain resulted in an increase in the number of goals and scoring opportunities. These previous studies measured the effectiveness of counter attacks by counting event-related items, such as long pass, 20-m run, and dribble. As a result, the effects of counter attacks for goal scoring and scoring opportunities were determined.

However, existing literature is limited to a descriptive analysis of counter attacks. Furthermore, factors associated with soccer skill related to counter attacks have not been studied. Skill is a trainable ability (Breivik, 2016), and to promote data-driven coaching for counter attacks, it is necessary to identify the skill factors involved in counter attacks and the relationships between these factors. Sport skills are components that cannot be directly measured; hence, they are estimated as common factors (latent variables) from the correlation structure among measurement items (observed variables) by applying exploratory factor analysis and confirmatory factor analysis. In previous studies, offensive and defensive skills were estimated based on performance items in soccer games.

Suzuki and Nishijima (2002) determined the skill structure and the causal structure of skills in the attacking phase of soccer by using structural equation modelling (SEM). They found that the attacking skills in soccer consisted of space-making, progression, and break skills. Moreover, they found that there were causal relationships between space-making skills to progression skills and progression skills to break skills. In addition, Suzuki and Nishijima (2004) analysed the defence skill structure and the causal structure between skills in soccer. Defensive skills comprised defensive phases (delaying attack, forcing play in one direction, squeezing the working space of attackers) and defensive targets (defence against an attacker with the ball, defence against attackers without the ball, defence to attacking space) in a multidimensional confirmatory factor structure model. Matsuoka et al. (2020) revealed the factor structure of defence tactical skills, control defence skills, and concentration defence skills by using defence play items, which were constructed by tracking the data of soccer games and by using exploratory factor and confirmatory factor analyses.

However, previous studies exploring counter attacks only analysed the relationships between game event items, which were measured from game performance and offensive outcomes. The skill factors involved in counter attack play have not been examined. With the recent development of data technology and data science, data on soccer games has been widely studied (Rein and Memmert, 2016; Memmert et al., 2016). Considering the development of data-driven coaching using game data analysis, it is essential to elucidate the skill factors involved in counter attack plays in soccer games and the causal structure between skills.

The purpose of this study was to investigate the factors and the causal structure of the counter attack skill in soccer.

2. Methods

2.1 Research procedure

The research procedure was divided into three parts: (1) qualitative analysis for constructing a qualitative causal structure and criterion-referenced measurement items of the counter attack skill; (2) confirmatory factor analysis of counter attack skills in soccer; and (3) causal structure analysis using SEM.

2.2. Samples

There were 275 counter attack plays collected from international matches and top football leagues during the 2019-2020 season (**Table 1**). Match videos were downloaded from the Wyscout platform (Wyscout Spa, Italy).

Table 1 Sample

Competitions (season)	*N* of samples	*N* of games
FIFA World Cup 2018	1	1
UEFA Champions League (2019-20)	89	23
UEFA Europe League (2019-20)	3	1
English Premiere League (2019-20)	19	8
Spanish La Liga (2019-20)	5	2
German Bundesliga (2019-20)	158	83
Total	275	118

The plays were collected from the start to the end of the possession. Plays that started with free kicks or corner kicks were excluded. The start of the possession corresponded to the ball gain from the opposing team, the goal kicks in the attacking team, and the throw-in. The end of play corresponded to the loss of ball possession by ball gain of the opposing team, halting of the possession (out of play), and offensive outcomes, such as shots and goals. The possession was considered to be continued when the attack was not interrupted, even if a player of the opposing team touched the ball during the possession.

The definition of counter attack proposed by Tenga et al. (2009; 2010a; 2010b) was used. They defined counter attack as "Counter attack: starts by winning the ball in play and progresses by either (a) utilizing or attempting to utilize a degree of imbalance from start to the end, or (b) creating or attempting to create a degree of imbalance from start to the end by using early (i.e. first or second, evaluated qualitatively) penetrative pass or dribble. Utilizing a degree of imbalance means seeking penetration in such a way that a defending team fails to regain a high degree of balance from start to the end of team possession. Counter attacks progress relatively quickly." In addition to this definition, counter attacks from quick transitions from goal kicks and throw-ins were also included in the analysis in this study because there was an opportunity to create imbalance. All collected plays were checked by four soccer experts to ensure that they met the definition.

Approval to conduct this study was obtained from the Ethics Committee of University of Tsukuba (Project No. 021-36).

2.3. Construction of the structure of the counter attack skills and measurement items

The measurement items for the soccer counter attack skills were constructed based on the procedure in the study by Matsuoka et al. (2020; 2021). The qualitative causal structure, criterion-referenced measurement items, and success criteria of the counter attack skills were determined by experts via the cause-and-effect analysis using the Delphi method. Four soccer experts participated in this study. Two were soccer players who had experience playing with the Japanese national team and professional clubs in Europe. One was a coach with more than 10 years of experience. The fourth was a graduate student who used to play soccer and who was engaged in sports science research. Three of them hold JFA Official class C coach license. They were experienced in using qualitative analysis methods. Individual interviews were conducted with the participants, and based on the extracted information, the researchers organised the data into a cause-and-effect (fishbone) diagram. The researchers then reported back to the soccer experts. The procedure was repeated until all the soccer experts agreed on the results.

Table 2 shows the playing phases, skills, measurement items, and success criteria for the counter attacks in soccer. The penetration phase consisted of 11 items covering three skills: four items for penetrative dribble, four items for lay off*[1], and three items for penetrative pass. The disorganisation of the opponent's defence phase consisted of six items covering two skills: two items for pushing down the opponent's defence line (DFL) skill and four items for disrupting the opponent's DFL skill. Counter attacks in soccer were measured using binary data, which were deemed either achieved (1) or unachieved (0), according to the success criteria of the measurement items. The success criteria were clearly illustrated in the pictures of the play. A single rater used these success criteria for measurement.

2. 4. Statistical analyses

A confirmatory factor structure model was constructed based on the qualitative causal structure of the counter attack skills, and a causal structure model was constructed based on the confirmatory factor structure. SEM was applied to analyse the confirmatory factor structure and causal structure of the counter attack skills based on the goodness-of-fit indices and the significance of the path coefficients in the measurement and structural models. Tetrachoric correlation matrices were calculated based on the achievement binary data, and diagonal weighted least squares was used as the estimation method (Rosseel, 2012). The statistical significance level was set at 5% ($p < 0.05$).

The goodness-of-fit indices included the comparative fit index (CFI), Tucker–Lewis index (TLI), root mean square error of approximation (RMSEA), standardised root mean square error of approximation (SRMR), χ^2 statistic (CHISQ), and significance probability (p). They were used to comprehensively determine the model fit. In general,

Table 2 Measurement items and success criteria of the soccer counter attack skills

Phases	Skills	No	Items	Success Criteria
Penetration	Penetrative dribble	V01	Dribbling over 15m	Carry the ball dribbling over 15m in the attacking direction
		V02	Dribbling into central lane	Carry the ball dribbling in the central direction
		V03	Dribbling into open space	Carry the ball to a position where the opponent player cannot touch
		V04	Dribbling cut	Carry the ball dribbling forward and cut in the direction of the centre of the pitch.
	Lay off	V05	Receive pass in short distance	Receive the ball closer than 2m from the passer
		V06	Direct pass	Pass the ball to a player with one touch
		V07	Drop pass	Pass the ball to backwards for a teammate
		V08	Target pass	Pass the ball to a target player who is with an opposing defender on his back
	Penetrative pass	V09	Through-pass	Pass between the opponent's two defenders and behind the opponent's DFL
		V10	Forward pass	Pass the ball to a player in the attacking direction
		V11	Gap pass	Pass the ball to a player who positions in the gap between the opponent's FWL-MFL or in the gap between the opponent's MFL-DFL
Disorganisation of the opponent's defence	Pushing down the opponent's DFL	V12	Pushing down MFL	Make the position of the opponent's MFL move toward the opponent's goal
		V13	Pushing down DFL	Make the position of the opponent's DFL move toward the opponent's goal
	Disrupting the opponent's DFL	V14	Creating space in behind of DFL	Create space behind of the opponents' DFL by drawing the opposing defender in the DFL to the ball carrier.
		V15	Breaking DFL	A player receive the ball in behind of the opponent DFL
		V16	Drawing DFL	Draw more than two opponent's DFL players on the side with the ball to create an open space
		V17	Disrupting DFL	Make the opponent DFL uneven (not flat)

Note: FWL stands for forward line, DFL stands for defense line, MFL stands for midfield line.

the CFI and TLI values are between 0.00 to 1.00. Values ≥ 0.95 are considered to be a good model fit. The value of TLI may exceed 1.0 (Kline, 2016). A value of zero in the RMSEA and SRMR corresponds to a perfect model fit, while larger values indicate a worse model fit. A worse model fit includes a good model fit (RMSEA ≤ 0.05) (Browne and Cudeck, 1993; Kline, 2016) and a poor model fit (> 1.00 in

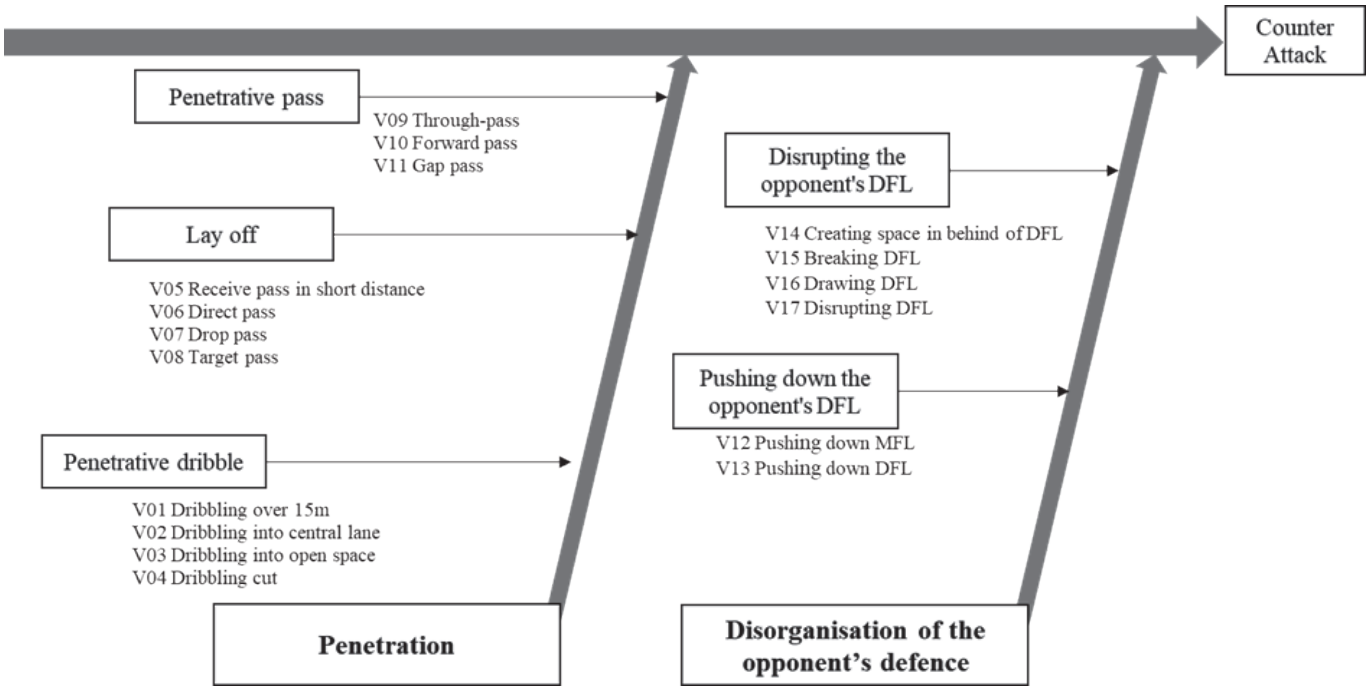

Figure 1 Cause-and-effect/fishbone diagram of the counter attack skill in soccer

Note: DFL stands for defense line, and MFL stands for midfield line.

SRMR) (Kline, 2016).

The statistical software R and *the lavaan* package were used for SEM.

3. Results

3.1. Qualitative causal structure and measurement item

Figure 1 shows the cause-and-effect (fishbone) diagram of the qualitative causal structure of the counter attack skill in soccer. The counter attack skills were consisted of penetration and disorganisation of the opponent's defence skills according to the phase of play. The penetration skills were consisted of penetrative dribble, lay off, and penetrative pass, and these three skills were measured by 11 measurement items, such as v01 dribbling over 15m. The disorganisation of the opponent's defence skill was consisted of pushing down and disrupting the opponent's DFL skill. These two skills were measured by six measurement items, including V13 pushing down DFL.

3.2. Confirmatory factor structure

Figure 2 shows the confirmatory factor structure of the soccer counter attack skill. The confirmatory factor structure model was constructed based on the qualitative causal structure shown in the cause-and-effect/fishbone diagram. The factor structure was confirmed by the goodness-of-fit and significance of the path coefficients. The goodness-of-fit indices showed that the CFI was 0.998, the TLI was 0.997, the RMSEA was 0.008, the SRMR was 0.099, and the CHISQ was 104.85 (df = 103, p = 0.43). The overall model fit was considered to be good.

All path coefficients from the latent variables (factors) to the measured items were statistically significant ($p < 0.05$). The path coefficients from the penetrative dribble to the four items ranged from 0.532 to 0.692, the path coefficients from lay off to the four items ranged from 0.745 to 0.853, and the path coefficients from penetrative pass to the three items ranged from 0.472 to 0.761. For the disorganisation of the opponent's defence skill, the path coefficients from pushing down the opponent's DFL to two items ranged from 0.713 to 0.804, while the path coefficients from disrupting the opponent's DFL to four items ranged from 0.301 to 0.827.

For the factor correlation, the correlation coefficient was 0.493 between penetrative dribble and pushing down the opponent's DFL, 0.393 between the lay off and penetrative pass, 0.457 between lay off and disrupting the opponent's DFL, and 0.548 between the penetrative pass and disrupting the

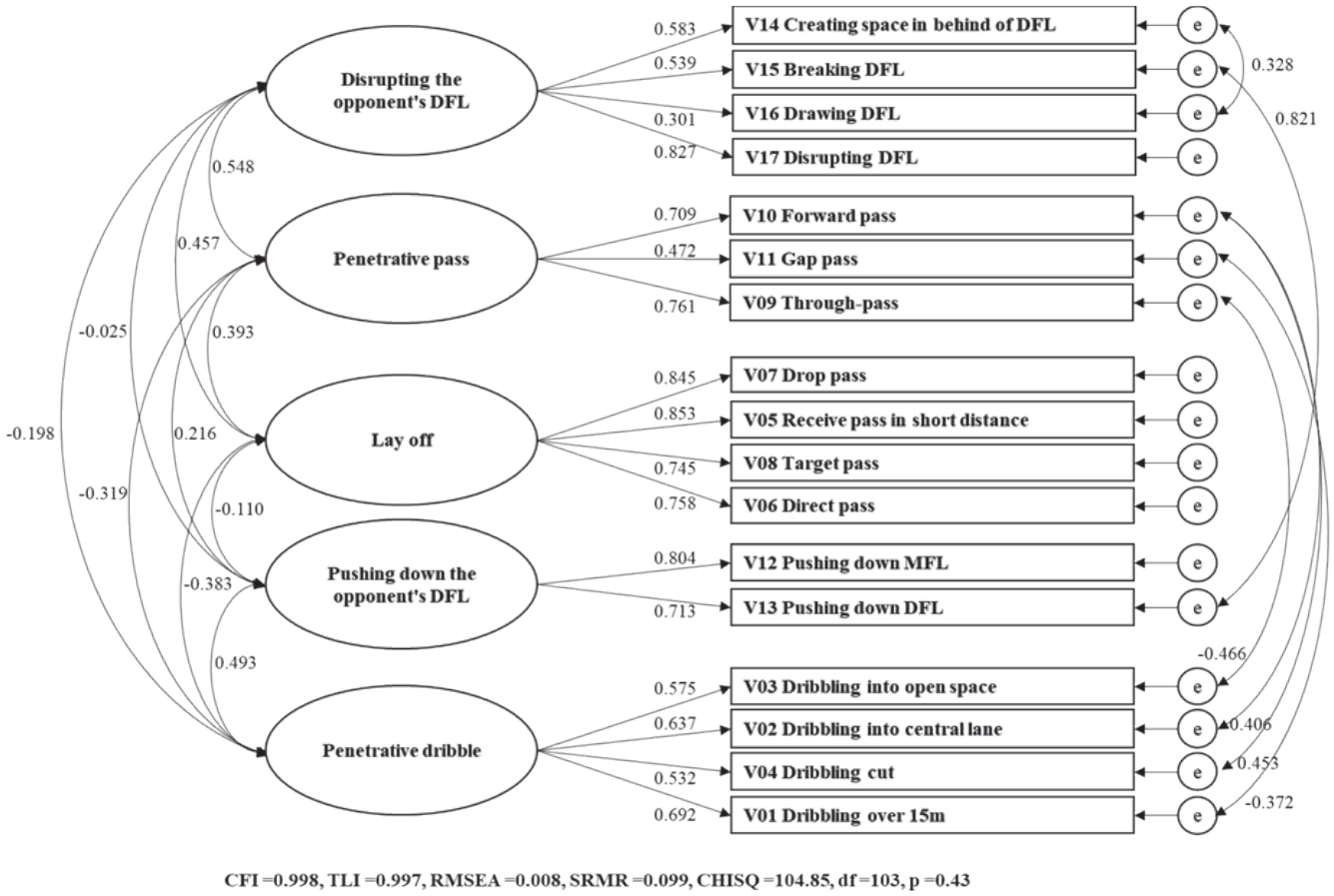

Figure 2 The confirmatory factor structure of the counter attack skill in soccer

Note: DFL stands for defense line, MFL stands for midfield line.

opponent's DFL. However, there was a negative factor correlation coefficient between the penetrative dribble and penetrative pass (-0.319), between the penetrative dribble and lay off (-0.383), and between the penetrative dribble and disrupting the opponent's DFL (-0.198). The factor correlation between disrupting the opponent's DFL and pushing down the opponent's DFL was -0.025.

3.3. Causal structure between skills

Figure 3 shows the causal structure of the soccer counter attack skill, which is a causal structure model of the skills following the phase of counter attacks constructed based on a confirmatory factor structure. The causal structure was confirmed by the goodness-of-fit and significance of the path coefficients. The model fit indices showed the following results: CFI = 0.979, TLI = 0.974, RMSEA = 0.024, SRMR = 0.108, CHISQ = 126.830 (df = 110, p = 0.13). The overall model fit was deemed to be good.

The path coefficients between the penetrative dribble and pushing down the opponent's DFL were 0.555, 0.588 between the lay off and penetrative pass, 0.265 between the penetrative pass and pushing down the opponent's DFL, and 0.653 between the penetrative pass and disrupting the opponent's DFL. The path coefficient between the penetrative dribble and lay was -0.433. The path coefficients from the latent variables to the 17 observed variables ranged from 0.285 to 0.848. All path coefficients were statistically significant ($p < 0.05$).

4. Discussion

The purpose of this study was to analyse the factors and causal structures of the counter attack skills in soccer. Qualitative analysis was conducted to construct the causal structure and measurement items of the counter attack skills. On the other hand, the confirmatory factor analysis via SEM confirmed the construct validity of the 17 measurement items of the counter attack skills in soccer. A causal structure model that assumes a causal relationship between

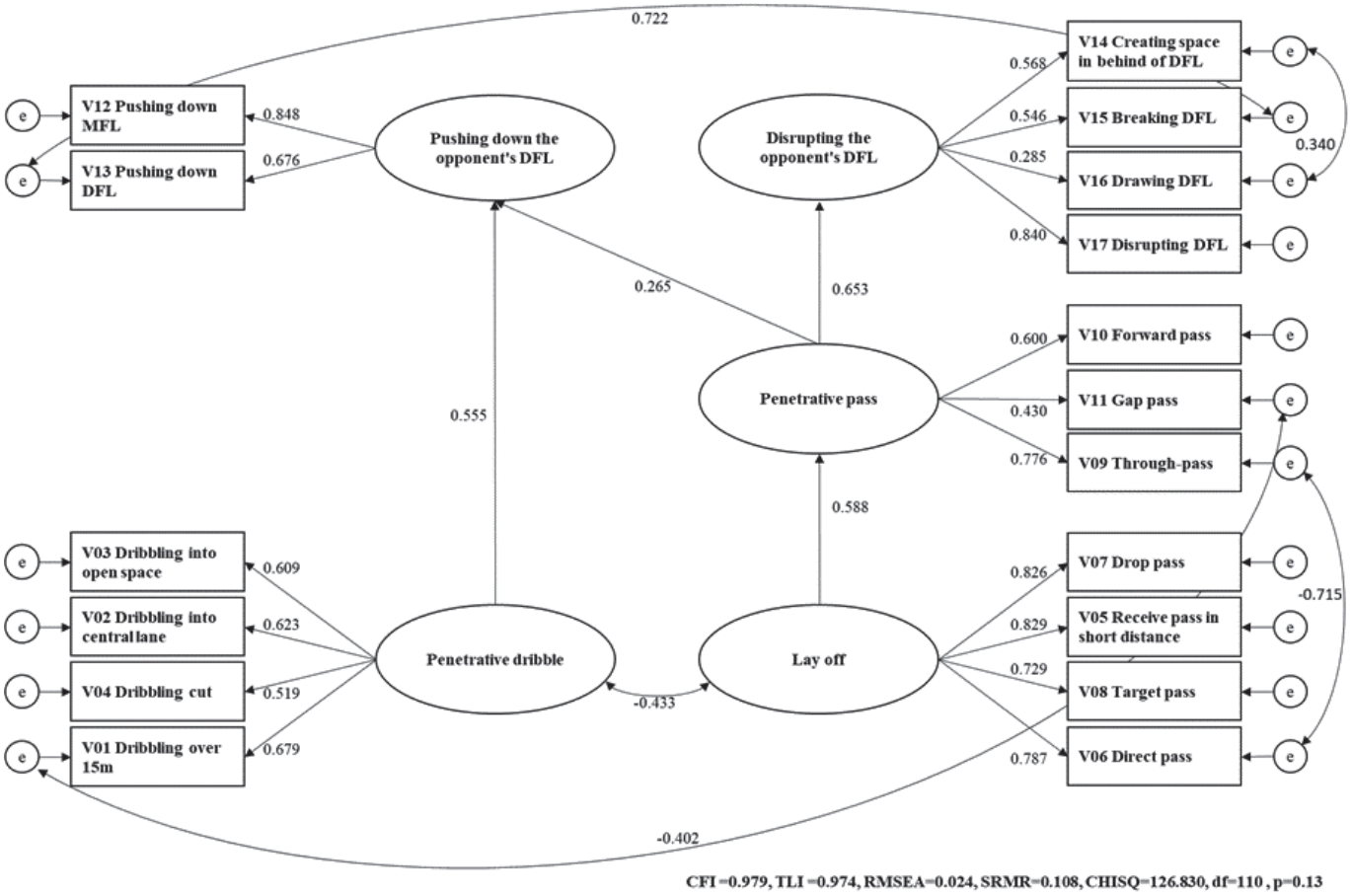

Figure 3 The causal structure of the counter attack skill in soccer

Note: DFL stands for defense line, MFL stands for midfield line.

the first factors can be used in the post-hoc analysis when factor correlations are found between the first factors of the confirmatory factor structure. Thus, the sequential causal structure model among soccer counter attack skills that follows the playing phase of counter attacks was analysed via SEM.

As shown in **Figure 3**, there are two types of sequential causal relationships between the soccer counter attack skills: (1) the penetrative pass and the lay off skills related to disrupting the opponent's DFL and (2) the penetrative dribble, the penetrative pass, and the lay off related to the push of the opponent's DFL down.

In the penetration phase, penetrative dribble and penetrative pass skills are related to the push down of the opponent's DFL skill. In particular, the path coefficient of the penetrative dribble skill to the push down the opponent's DFL was as high as 0.555, which indicates a moderate causal relationship. In previous studies, Tenga et al. (2009: 2010a; 2010b) stated that the counter attack was an offence play that created a degree of imbalance through an early penetrative pass or dribble. Hughes and Lovell (2019) reported that dribbling in the first or the second action after ball gain increased goal scoring opportunities. Dribbling forward immediately after ball gain before the opponent team creates a defensive formation is crucial in increasing offensive chances and is measured as the highest path coefficient from the penetrative dribble skill to "V01 15 m dribble." This suggests that the long dribble to approach the opponent's goal before the opposing team is organised to force the opponent team's DFL to move back to their own goal. Therefore, it is obvious that the penetrative dribble skill toward the opponent's goal, such as dribbling more than 15 m, is related to the skill of pushing down the opponent's DFL.

Penetrative pass skill is related to the disruption of the opponent's DFL skill. The skill related to the penetrative pass is the lay off skill, and there is the sequential causal relationship between the former and the latter. Disorganizing the opposing team's defensive

shape is one of the key principles of soccer attacks (da Costa et al., 2009; Hewitt et al., 2016). Moreover, the importance of measuring the interaction between the members of the opposing team has been suggested (Tenga et al, 2009; Tenga et al. 2010a; Tenga et al. 2010b; Lago-Ballesteros et al. 2012; Matsuoka et al. 2021a). With regards to the opponent's interaction, Tenga et al. (2010a; 2010b) reported a low effect of the counter attacks on the opponents' balanced defence. In addition, penetrative passes and long passes (> 25 m) are important for the counter attacks (Tenga et al., 2010a; Tenga et al., 2010b; Lago-Ballesteros et al., 2012; Hughes and Lovell 2019). In this study, the path coefficient from the penetrative pass skill to V09 through pass was the highest, while the path coefficient from the penetrative pass skill to the disruption of the opponent's DFL skill was also high. Thus, penetrative pass skill is crucial to create an imbalance in the opponent's defensive shapes and in disrupting the opponent's DFL skill.

Lay off skills are involved in the offensive player positions between the MFL and the DFL of the opposing team and in the skill factors related to penetrative pass skills. The item that measures the lay-off skill in this study is the V05 Receive pass in short distance and V07 Drop pass, which involves passing between the opposing team's DFL and MFL defensive lines. Suzuki et al. (2018) found that attacking through the space between the opposing defender and midfielder was effective and was considered to be a lay-off skill that led to a play that broke the opposing team's DFL on the next action. From these results, it is clear that the sequential causal relationship is present between the lay off skill and penetrative pass skill and between the penetrative pass skill and the disruption of the opponent's DFL skill.

A significant negative correlation coefficient of -0.433 was found between the penetrative dribble and lay-off skills. In this study, all items were measured using the binary data, while the causal structure model was analysed using the tetrachoric correlation matrix. The negative factor correlation coefficients indicated that either the penetrative dribble skill or the lay-off skill was related to one of the factors. In other words, according to the principle of passing or dribbling in soccer attacking tactics, either passing or dribbling is selected in the counter attack play. Although situations in which the involvement of the skill of the penetration phase remains unknown, the findings of this study are useful for data-driven coaching in soccer.

The causal structure analysis via SEM shows the sequential causal relationship among the soccer counter attack skills that follows the phase of the counter attacks. There is the sequential causal relationship between the penetrative dribble skills to pushing down the opponent's DFL skill and between the lay-off skill to pushing down the opponent's DFL skill and disrupting the opponent's DFL skill through the penetrative pass skill.

The correlation coefficients between the error variable were considered to be soccer skills that were not explained by the model in this study. Measurement items, V13, V14, V15, and V16 in **Figures 2** and **3** are all measures of the opposing DFL These can represent skills in pushing down and disrupting the opposing DFL. Additionally, these were not accounted for in the model in this study. For example, V13 Pushing down DFL measures "make the position of the opponent's DFL move toward the opponent's goal", while V15 Break DFL measures "a player receives the ball behind the opponent's DFL". Thus, the correlation between the error variable in the two items shows that there is a skill involved in a series of plays involving pushing down the opposing DFL and breaking through it.

Based on the correlations between the error variables of the passing-related and dribbling-related measures in **Figure 2**, it can be assumed that there are skills that require both passing and dribbling, such as pass-to-dribble and dribble-pass. The model in this study accounts for penetrative pass skill and penetrative dribble skill. However, the model in this study does not account for skills that deal with both passing and dribbling, such as pass-to-dribble and dribble-pass. Negative correlation coefficients were obtained between the error variables for V09 Through-pass and V06 Direct pass and between V01 Dribbling over 15m and V11 Gap pass are shown in **Figure 3**. Since the variables in this study were measured using the achievement binary data, the negative correlation coefficients indicated that when one of the measures was achieved, the other was not. The soccer skills which are not explained in the model in this study should be investigated in future studies.

The sample size was one of the limitations of this study. The sample size for this study was 275 counter attack plays collected from 118 games that occurred in the seven leagues of the FIFA World Cup, UEFA

Champions League, UEFA Europe League, English Premiere League, Spanish La Liga, and German Bundesliga, which are among the top leagues of the UEFA. These leagues are presented in **Table 1**. The findings in this study were generalised within these samples. However, they cannot be applied and generalised to all populations involved in soccer games.

5. Conclusion

The purpose of this study was to investigate the factor and the causal structure of the counter attack skill in soccer. We found that the counter attack skills in soccer consisted of penetrative dribble, lay-off, penetrative pass, pushing down the opponent's DFL, and disrupting the opponent's DFL skills. Moreover, we found that there was the sequential causal relationship between the counter attack skills in soccer that followed the phase of play from the penetrative dribble skill to the pushing down of the opponent's DFL skill, from the lay-off skill to the penetrative pass skill, from the penetrative pass skill to the pushing down of the opponent's DFL skill, and from the penetrative pass skill to the disrupting the opponent's DFL skills.

The limitations of this study include the sample size, measurement items, and statistical analysis methods. From the perspective of measurement science, follow-up research on the analysis of the counter attack skills and measurement items is necessary as these develop over time.

Note

*1 A lay off is a play in which the same team player in the space between opposing defensive players who receives a short pass drops it with one touch to a teammate facing forward.

References

Barnes, C., Archer, D. T., Hogg, B., Bush, M., and Bradley, P. (2014). The evolution of physical and technical performance parameters in the English Premier League. Int. J. Sports Med., 35: 1095-1100.

Breivik, G. (2016). The role of skill in sport. Sport, Ethics and Philosophy, 10: 217-221.

Browne, M. W., and Cudeck, R. (1993). Alternative ways of assessing model fit. In: Bollen. K. A. and Long. J. S. (eds.), Testing structural equation models. Newbury Park, Sage.

da Costa, I. T., da Silva, J. M. G., Greco, P. J., and Mesquita, I. (2009). Tactical principles of soccer: Concepts and application. Motriz, 15: 657-668.

FIFA.(2018). Technical report 2018 FIFA World Cup Russia.

Hughes, M., and Lovell, T. (2019). Transition to attack in elite soccer. J. Hum. Sport Exerc., 14: 236-253.

Hewitt, A., Greenham, G., and Norton, K. (2016). Game style in soccer: What is it and can we quantify it? International Journal of Performance Analysis in Sport, 16: 355-372.

Kline, R. B. (2016). Principles and practice of structural equation modelling. Guilford Publications.

Lago-Ballesteros, J., Lago-Peñas, C., and Rey, E. (2012). The effect of playing tactics and situational variables on achieving score-box possessions in a professional soccer team. J. Sports Sci., 30: 1455-1461.

Matsuoka, H., Tahara, Y., Ando, K., and Nishijima, T. (2020). Development of criterion-referenced measurement items of soccer defensive tactical play from tracking data. Football Science, 17: 29-40.

Matsuoka, H., Tahara, Y., Ando, K., and Nishijima, T. (2021a). Development of criterion-referenced measurement items of defensive transition in soccer games from tracking data. Int. J. Sport Health Sci., 19, 87-97.

Matsuoka, H., Tahara, Y., Ando, K., and Nishijima, T. (2021b). Identification of soccer defensive transition play using latent class analysis. Football Science, 18: 60-71.

Memmert, D., Lemmink, K. A., and Sampaio, J. (2016). Current approaches to tactical performance analyses in soccer using position data. Sports Med., 47: 1-10.

Rein, R., and Memmert, D. (2016). Big data and tactical analysis in elite soccer: Future challenges and opportunities for sports science. SpringerPlus, 5: 1-13.

Rosseel, Y. (2012). Lavaan: An R package for structural equation modelling and more. Version 0.5-12 (BETA). J. Stat. Softw., 48, 1-36.

Suzuki, K. and Nishijima, T. (2002) Causal structure of the attacking skill in soccer games. Jpn J. Phys. Educ. Health Sport Sci., 47: 547-567. (in Japanese).

Suzuki, K. and Nishijima, T. (2004). Validity of a soccer defending skill scale (SDSS) using game performances. Int. J. Sport Health Sci., 2: 34-49.

Suzuki, K., Asai, T., Hirashima, Y., Matsutake, T. and Nakayama, M. (2018). Examination of attack effectiveness using the gap between an opposing defender and midfielder in football and comparison of the attack strategy between the J League and the Bundesliga. Jpn J. Phys. Educ. Health Sport Sci., 63: 785-797. (in Japanese).

Tenga, A., Holme, I., Ronglan, L. T., and Bahr, R. (2010a). Effect of playing tactics on goal scoring in Norwegian professional soccer. J. Sports Sci., 28: 237-244.

Tenga, A., Holme, I., Ronglan, L. T., and Bahr, R. (2010b). Effect of playing tactics on achieving score-box possessions in a random series of team possessions from Norwegian professional soccer matches. J. Sports Sci., 28: 245-255.

Tenga, A., Kanstad, D., Ronglan, L,T., and Bahr, R. (2009). Developing a new method for team match performance analysis in professional soccer and testing its reliability. Int. J. Perform. Anal. Sport., 9: 8-25.

Wallace, J. L., and Norton, K. I. (2014). Evolution of World Cup soccer final games 1966-2010: Game structure, speed and play patterns. J. Sci. Med. Sport, 17: 223-228.

Name:
Hiroki Matsuoka

Affiliation:
Faculty of Health and Sport Sciences, University of Tsukuba

Address:
1-1-1 Tennodai, Tsukuba, Ibaraki 305-8574 Japan

Brief Biographical:
2015-2017 Master's Program in Health and Sport Sciences, Graduate School of Comprehensive Human Sciences, University of Tsukuba
2017-2020 Doctoral Program in Physical Education, Health and Sport Sciences, Graduate School of Comprehensive Human Sciences, University of Tsukuba
2021-2022 Faculty of Health and Sport Sciences, University of Tsukuba
2022-present R&D Center for Sport Innovation, University of Tsukuba

Main Publications:
- Matsuoka, H., Tahara, Y., Kozue, A., and Nishijima, T. (2021). Development of criterion-referenced measurement items of defensive transition in soccer games from tracking data. International Journal of Sport and Health Science, 19: 87-97.
- Matsuoka, H., Kozue, A., and Nishijima, T. (2021). Identification of soccer defensive transition play using latent class analysis. Football Science, 18: 60-71.

Membership in Learned Societies:
- Japan Society of Physical Education, Health and Sport Sciences
- Japanese Society of Science and Football