EXPERT AND QUANTITATIVE EVALUATION OF GAME PHASES IN HANDBALL

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Abstract

The research has been conducted with the purpose of doing expert and quantitative valorisation of the importance of four game phases in handball: position attack, position defence, transition attack and transition defence. The sample of entities involved 19 elite international handball experts and 44 matches played at the World Handball Championship for Men. We established defence phases are more important than attack phases in addition to higher efficiency and significance of transition phases compared to position phases. With regard to the research findings, we quantitatively determined the most efficient game phase combinations in handball, separately and integrally with the opposed team. Research results can contribute to the efficiency of the training process by using most useful contrasted game phase models, but also to the quality tactical preparedness and in addition to managing the match itself.

Key words: *team handball, tactical activities, coaching, attack, defence, transition.*

Introduction

During its historical development, as any other sport game, handball underwent a kinesiological adjustment following the change of the rules, enhancing material-technical and organization conditions at training and competitions, and particularly due to implementation of new and scientifically based training processes and selection methods (Bjorndal, Luteberget, Till, & Holm, 2018; Wagner et al., 2019). All of these factors added to the fact handball is nowadays one of the most popular and most widespread ball games. It is characterized by a simply defined aim, and that is scoring as many, i.e. receiving as few goals as possible. This aim is affected by a large number of factors, particularly by technical and tactical knowledge, physical potential, morphological characteristics and mental-emotional features of players, by the opponent's performance and outer environmental influences (Weber, Wegner, & Wagner, 2018). Accomplishing the partial game aim in attack or defence, i.e. scoring or preventing to score, does not entirely depend on the activity and abilities of a player immediately involved in finalisation, but is, to a large extent, the outcome of cumulative performance of other players and their synchronized group and collective actions followed by the activity of the opposed team.

A handball game is performed within a time framework defined by its single time periods, i.e. game phases. Game phases are determined by ball possession and temporal-spatial features of technical-tactical activity implementation (Rogulj, 2003). Regarding ball possession, we distinguish two basic game phases, attack and defence, while with regard to kinesiological aspect of the game, there is attack and defence game transition (Foretić, Rogulj, & Trninić, 2010a). Thus, phases present separate time units of the game with a distinguishing and specific kinesiological structure, performed in different order combinations during a game.

Problem

In practice, coaches are not sufficiently familiarized with the valuation and significance of a certain game phase, and they are even less focused on the frequency of certain phases in a training process in accordance with their contribution to the result efficiency. Due to not understanding or not being aware of the importance of a certain game phase, training time is used in a wrong and irrational way where training phases least important for the result are most frequently practiced, and those of the greatest importance are practiced occasionally or almost never. Due to the lack of deeper consideration, empirical knowledge or scientific proofs, this is how trainers most frequently view the hierarchical order and their frequency in training: 1 – position attack, 2 – position defence, 3 – transition attack, 4 – transition defence. Logics suggest that defence is more crucial than attack, since if we are efficient in defence, and inefficient in attack afterwards, we are not losing, we are equal. However, being inefficient in defence does not suggest we are winning even if efficient in attack, we are simply equal. In order to bring ourselves to the point of being efficient in position defence, primarily we must return to the zone of position defence action, thus, hypothetically, transition defence is being imposed as the most important game phase in handball. The importance of a certain game phase and its contribution to the match outcome can be established by experimental and empirical procedures (Foretic, Rogulj, & Papic, 2013). Experimentally we have to determine the relation between playing position and transition frequency in winning and losing teams, average efficiency of a certain phase with relation to scoring or not receiving a goal and the difference in the efficiency of performing the finalization of certain phases between winning and losing teams. Empirical procedures analyse the expert knowledge of top handball scientists and experts with the purpose of their subjective assessment of a certain game phase. Previous researches on tactical activities in handball were mostly focused on the analysis of parameters and indicators of situation activity and efficiency describing mostly individual (Srhoj, Rogulj, Padovan, & Katic, 2001), and rarely group and collective tactical performances (Bilge, 2012; Hianik, 2011; N. Rogulj, Srhoj, & Srhoj, 2004). Tactical performances are most frequently analysed with regard to playing positions (Massuça, 2011), court zones (Vuleta, Milanović, & Sertić, 1999), time distance (Šibila, Bon, Mohorič, & Pori, 2011), team quality (Sanja, Rogulj, & Ceković, 2016) or result (Foretić, Rogulj, & Trninić, 2010b), and very rarely with regard to the time course of the match (Rogulj, Foretić, & Burger, 2011) or the opposed tactical activity of the opponent (Rogulj, 2009). Game phase researches are fairly rare in sport games and there are not any in handball. Thus, the implementation of this research is, on one hand, initiated by the importance of subject issue in everyday professional and training practice, and on the other, by the fact that until now, it has not been systematically studied in a professional or scientific manner.

Aim

In accordance with what was stated above, the intention of this paper is to make an experimental evaluation with result significance of different game phases in handball by analysing differences in frequency and implementation efficiency of certain phases between efficient an inefficient teams with relation to result. In addition to experimental, the purpose of the team is to perform an expert game phase evaluation and based on research results, to define efficient training models based on combinations of different phases.

Methods

The sample of variables

The sample of variables of the expert evaluation has been defined by four basic game phases: position attack (PONA), position defence (POOB), transition attack (TRNA) and transition defence (TROB). *Position attack* is a part of a game where one team possesses the ball and with all the players attacks the position defence of the opposed team. The main goal is scoring which also presents the materialisation and the resultant of individual, group or collective players' performance. *Position defence* is a part of the game when the team does not possess the ball and is in the given formation. The main aim of the position defence is to retrieve the ball without receiving a goal. This aim can be achieved by contact performance of defence players directed towards the attacker's body, but also by contactless performance directed towards space and ball. *Attack transition* is a part of the game starting with one team retrieving the ball and characterized by trying to score as fast as possible, i.e. by gaining spatial-temporal advantage over the opponent while he is still not completely prepared for defence. This phase is performed by individual, group or collective counter attack, or the so-called lengthened counter attack. *Defence transition* is a part of the game after the attack when the team does not possess the ball, but organizes defence by a fast return and given formation. The main goal of the defence transition is to prevent counter attack and attack on a disorganized defence. One player, a group of players or a whole team can participate in these activities, but, as in position defence, the defence players' performance is with or without contact.

From four basic variables, we formed eight reciprocal ones:

1) The number of total position attacks (PONAUKU) matching the number of total opponent position defences (POOBUKU)
2) The number of position attacks with a positive outcome, i.e. with a scored goal (PONAUSP) which is the number of opponent position defences with a negative outcome, i.e. with a received score (POOBNEU)
3) The number of position attacks with a negative outcome, i.e. lost balls without scoring (PONANEU) which is the number of opponent position defences with a positive outcome, i.e. without receiving a goal (POOBUSP)
4) The efficiency of position attack, i.e. quotient of efficient and the total number of position attacks (EFIPONA) which matches the inefficiency of the opponent position defence, i.e. quotient of inefficient and total number of position defences (NEFIPOOB)
5) The number of total transition attacks (TRNAUKU) which matches the number of total opponent transition defences (TROBUKU)
6) The number of transition attacks with a positive outcome, i.e. with a scored goal (TRNAUSP) which matches the number of opponent transition defences with a negative outcome, i.e. with a received goal (TROBNEU)
7) The number of transition attacks with a negative outcome, i.e. the loss of ball without scoring (TRNANEU) which matches the number of opponent transition defences with a positive outcome, i.e. without receiving a goal (TROBUSP)
8) Transition attack efficiency, i.e. quotient of efficient and the total number of transition attacks (EFITRNA) which matches the inefficiency of the opponent position defence, i.e. the quotient of inefficient and the total number of transition defences (NEFITROB)

The variables were analysed separately for winning and losing teams (prefix POB or POR in variable abbreviation).

The sample of entities

The research was conducted on the sample of 44 matches played in the group phase of the World Handball Championship for Men in Spain in 2013. Since two opposed teams participate in every match, the total entities number is 88.

Expert assessors' sample
The sample of assessors who assessed the importance of individual game phases involved 19 handball experts from 12 European countries where handball plays a significant role and has had long-term tradition over the years.

All of the experts have long-term training experience in professional clubs or national teams and top results at official international club and national team competitions. Additionally, fourteen experts have a PhD in handball science and they teach handball subjects at kinesiological faculties, while the others have BS in kinesiology, handball major. The experts have assessed the significance of individual game phases for result efficiency on Likert's scale from 1 to 5.

Data processing methods
For the purpose of basic descriptive analysis of marked variables and experts marks, we applied the following statistical parameters: arithmetic means (X), standard deviation (SD), minimum (MIN) and maximum (MAX) result value, asymmetry coefficient (SKEW) and kurtosis coefficient (KURT) and maximum deviation of the relative cumulative empirical frequency from relative cumulative theoretical frequency (max D). Normality distribution testing was done by Kolmogorov-Smirnov test with the error tolerance level up to 5% (KS). To establish objectivity of the expert assessment, we calculated Cronbach alpha (α) reliability coefficient. Differences in variables between winning and losing teams were established by non-parametrical Kruskal-Wallis test.

Results

Table 1. Basic descriptive and distribution parameters of experts' marks and Cronbach alpha reliability coefficient.

Variable	X	MIN	MAX	SD	SKEW	KURT	MAX D
PONA	3.37	1.00	5.00	1.67	-0.42	-1.45	0.26
POOB	4.37	3.00	5.00	0.68	-0.63	-0.53	0.29
TRNA	4.36	2.00	5.00	0.83	-1.48	2.41	0.30
TROB	4.47	3.00	5.00	0.61	-0.70	-0.31	0.33
Cronbach alpha coefficient				0.84			

Test=0.37 (p=0.05)

By analysing table 1 which presents basic descriptive and distribution parameters of the experts' marks, it is evident that all the variables are normally distributed and there are no extreme deviations or data dispersion. All the variables are slightly negatively asymmetrical, i.e. they have a tendency towards higher values. The highest average data deviation from the arithmetic means is in PONA variable which suggests that experts were mostly indecisive about assessing position attack variable. In the experts' opinion, the highest mark and the greatest significance for result efficiency is given to transition defense phase (4.47), followed by position defense (4.37) and transition attack (4.36), and the lowest mark is given to the position attack (3.37).

Regarding the fact these are top handball experts with long-term competition experience, not surprisingly the highest significance has been given to transition defense, i.e. preventing fast opponents' attacks. The greatest significance was given to position defense as a precondition to perform fast transition attack also recognized as an essential one, while position attack is considered to be the least important handball game phase.

The same table presents Cronbach alpha experts' reliability coefficient. It is relatively high and measures 0.84 which is considered to be satisfyingly reliable, particularly considering the fact that experts' sample is relatively large compared to the sample of variables.

Table 2. Basic descriptive and distribution variable parameters separately for winning and losing teams.

Variable	X	MIN	MAX	SD	SKEW	KURT	MAX D
POBPONAUKU	46.34	36.00	58.00	4.54	0.20	-0.01	0.10
POBPONAUSP	24.95	18.00	31.00	3.26	-0.14	-0.40	0.09
POBPONANEU	21.39	13.00	32.00	4.34	0.27	-0.21	0.08
POBEFIPONA	0.54	0.39	0.70	0.07	-0.27	-0.08	0.12
POBTRNAUKU	6.89	1.00	15.00	3.66	0.51	-0.33	0.12
POBTRNAUSP	5.59	1.00	13.00	3.32	0.62	-0.46	0.14
POBTRNANEU	1.30	0.00	5.00	1.29	0.79	0.10	0.21
POBEFITRNA	.82	0.29	1.00	0.19	-0.96	0.20	0.19
PORPONAUKU	45.36	34.00	53.00	4.14	-0.31	0.16	0.11
PORPONAUSP	20.77	12.00	28.00	3.79	-0.54	-0.22	0.12
PORPONANEU	24.59	16.00	35.00	4.70	0.51	-0.33	0.16
POREFIPONA	0.46	0.26	0.60	0.08	-0.75	0.15	0.13
PORTRNAUKU	4.86	1.00	13.00	2.75	0.93	0.61	0.14
PORTRNAUSP	3.36	0.00	11.00	2.17	1.27	2.39	0.20
PORTRNANEU	1.50	0.00	7.00	1.45	1.95	4.58	0.29
POREFITRNA	0.69	0.00	1.00	0.23	-0.52	0.33	0.11

Test=0.25 (p=0.05)

Table 2 displays basic descriptive and distribution parameters of the analysed variables separately for winning and losing teams. It is evident these variables are normally distributed and there are no extreme deviations or data dispersion apart from the unrealized transition attack variable in losing teams (PORTRNANEU) where distribution is more significantly leptokurtic and positively asymmetric with the result tendency towards lower values.

From the obtained results, we may calculate the average number of transition attacks (5.87) and position attacks (45.85) for all the teams, proportional to the number of transition and position defences. The frequency percentage of transition attack with regard to the total number of attacks in all the teams is 11%, and 89% for position attack. However, a more significant difference in the number of transition attacks is evident in favour of winning compared to losing teams. Namely, the number of transition and position attacks in the winning teams is 15%, and in losing teams as little as 10%. The average efficiency of position attack in all the teams is 50%, and 75% in transition attack. There is also a significant difference in position and transition attack efficiency in favour of winning teams compared to losing teams.

Table 3. The Kruskal-Wallis test results between winning and losing teams.

Variable	X POB	X POR	H	p
PONAUKU	46.34	45.36	1.67	0.20
POOBUKU	45.36	46.34	1.67	0.20
PONAUSP	24.95	20.77	10.23	0.00
POOBNEU	20.77	24.95	10.23	0.00
PONANEU	21.39	24.59	2.93	0.09
POOBUSP	24.59	21.39	2.93	0.09
EFIPONA	0.54	0.46	14.73	0.00
NEFIPOOB	0.46	0.54	14.73	0.00
TRNAUKU	6.89	4.86	5.50	0.02
TROBUKU	4.86	6.89	5.50	0.02
TRNAUSP	5.59	3.36	9.21	0.00
TROBNEU	3.36	5.59	9.21	0.00
TRNANEU	1.30	1.50	0.44	0.51
TROBUSP	1.50	1.30	0.44	0.51
EFITRNA	0.82	0.69	6.55	0.01
NEFITROB	0.69	0.82	6.55	0.01

Table 3 displays results of non-parametrical Kruskal-Wallis test between winning and losing teams. Variables related to efficiently performed attack, i.e. reciprocally to inefficiently performed defence, statistically distinguish winning from losing teams both in position and transition phases.

Variables related to inefficiently performed attack due to missed shots or lost balls, i.e. reciprocally to efficiently performed defence, statistically do not have any significance in distinguishing winning from losing teams either in position or transition phases.

Variables referring to the total number of performed attacks, i.e. reciprocally to the total number of performed defences, statistically have significance in distinguishing winning from losing teams in the transition phase, but not in the position phase.

Variables related to efficiency, i.e. reciprocally to inefficiency of the opponent game phase regarding the relation between efficient (inefficient) attacks (defences), statistically significantly distinguish winning from losing teams both in position and transition phase.

Research results reveal that in addition to efficiency, and at the same time proportionally to inefficient defence or attack performance in position or transition phase, result efficiency is primarily determined by a larger number of transition than position attacks. The efficiency performance of transition attacks compared to position attacks is far more important in distinguishing winning from losing teams.

Based on the results of expert assessment of game phases result significance in handball, which are in accordance with the results obtained by analysing matches, we established quantitative values of different combinations in certain phases.

We analysed all plausible two-phase, three-phase and four-phase combinations without repetitions which match the logical exchange of attack and defence phases. In four-phase combinations, we analysed repeating combinations, with the limitation of one phase being repeated twice at the most and not one after another.

A great number of analysed combinations fully matches the natural continuity of the match course where there is always a transition phase among position phases, while a smaller number of combinations marked with an asterisk present discontinuing combinations easily created in training conditions.

Significance ponders of a certain combination has been defined as a sum of average experts' marks of certain phases importance, and total importance ponder of the contrasted model as the sum of combination phases ponders in the engaged attacking team and the opposed defence team (table 4).

Table 4. Combination of game-phase importance ponders.

Engaged A		Contrasted B		MOD
KOMB	PON	KOMB	PON	
TWO-PHASE				
TRNA-TROB	8.83	TROB-TRNA	8.83	17.66
TROB-POOB	8.84	TRNA-PONA	7.73	16.57
TRNA-POOB*	8.73	TROB-PONA*	7.84	16.57
PONA-TROB	7.84	POOB-TRNA	8.73	16.57
PONA-POOB*	7.74	POOB-PONA*	7.74	15.48
THREE-PHASE				
TRNA-TROB-PONA*	12.2	TROB-TRNA-POOB*	13.2	25.4
TRNA-TROB-POOB	13.2	TROB-TRNA-PONA	12.2	25.4
TRNA-PONA-TROB	12.2	TROB-POOB-TRNA	13.2	25.4
PONA-TROB-TRNA	12.2	POOB-TRNA-TROB	13.2	25.4
TRNA-PONA-POOB*	12.1	TROB-POOB-PONA*	12.2	24.3
TRNA-POOB-PONA*	12.1	TROB-PONA-POOB*	12.2	24.3
PONA-TROB-POOB	12.2	POOB-TRNA-PONA	12.1	24.3
PONA-POOB-TRNA*	12.1	POOB-PONA-TROB*	12.2	24.3
FOUR-PHASE WITHOUT REPETITION				
PONA-POOB-TRNA-TROB*		POOB-PONA-TROB-TRNA*		
PONA-TROB-POOB-TRNA		POOB-TRNA-PONA-TROB		
PONA-TROB-TRNA-POOB		POOB-TRNA-TROB-PONA		
TRNA-PONA-TROB-POOB	16.6	TROB-POOB-TRNA-PONA	16.6	33.2
TRNA-TROB-PONA-POOB*		TROB-TRNA-POOB-PONA*		
TRNA-TROB-POOB-PONA		TROB-TRNA-PONA-POOB		
TROB-PONA-POOB-TRNA*		TRNA-POOB-PONA-TROB*		
FOUR-PHASE WITH LIMITED REPETITION				
TRNA-TROB-TRNA-TROB	17.66	TROB-TRNA-TROB-TRNA	17.66	35.32
TRNA-TROB-TRNA-PONA	16.56	TROB-TRNA-TROB-POOB	17.67	34.23
TRNA-TROB-TRNA-POOB*	17.56	TROB-TRNA-TROB-PONA*	16.67	34.23
TRNA-TROB-PON-TROB*	16.67	TROB-TRNA-POOB-TRNA*	17.56	34.23
TRNA-TROB-POOB-TRNA	17.56	TROB-TRNA-PONA-TROB	16.67	34.23
TRNA-PONA-TROB-TRNA	16.56	TROB-POOB-TRNA-TROB	17.67	34.23
TRNA-POOB-TRNA-TROB*	17.56	TROB-PONA-TROB-TRNA*	16.67	34.23
PONA-TROB-TRNA-TROB	16.67	POOB-TRNA-TROB-TRNA	17.56	34.23
TRNA-PONA-TROB-PONA*	15.57	TROB-POOB-TRNA-POOB*	17.57	33.14
TRNA-PONA-POOB-TRNA*	16.46	TROB-POOB-PONA-TROB*	16.68	33.14
TRNA-POOB-TRNA-PONA*	16.46	TROB-PONA-TROB-POOB*	16.68	33.14
TRNA-POOB-TRNA-POOB*	17.46	TROB-PONA-TROB-PONA*	15.68	33.14
PONA-TROB-TRNA-PONA	15.57	POOB-TRNA-TROB-POOB	17.57	33.14
PONA-TROB-PONA-TROB*	15.68	POOB-TRNA-POOB-TRNA*	17.46	33.14
TRNA-PONA-POOB-PONA*	15.47	TROB-POOB-PONA-POOB*	16.58	32.05
TRNA-POOB-PONA-POOB*	16.47	TROB-PONA-POOB-PONA*	15.58	32.05
PONA-TROB-PONA-POOB*	15.58	POOB-TRNA-POOB-PONA*	16.47	32.05
PONA-TROB-POOB-PONA*	15.58	POOB-TRNA-PONA-POOB*	16.47	32.05
PONA-POOB-TRNA-PONA*	15.47	POOB-PONA-TROB-POOB*	16.58	32.05
PONA-POOB-TRNA-POOB*	16.47	POOB-PONA-TROB-PONA*	15.58	32.05
PONA-POOB-PONA-TROB*	15.58	POOB-PONA-POOB-TRNA*	16.47	32.05
PONA-POOB-PONA-POOB*	15.48	POOB-PONA-POOB-PONA*	15.48	30.96

*discontinuous combinations

In two-phase combinations the greatest importance ponder is the combination of transition defence-position defence (8.84), and then transition defence-transition attack (8.83). Combination transition attack – position attack (7.73) is the least significant. We may state that among two-phase combinations in the training process, it is most purposeful to use the model of fast return in defence and fast setting of position defence.

The most useful contrasted model is the transition model (17.66). In three-phase combinations, the most significant ones are those involving transition attack and defence phases (13.2), and the least significant ones are the combinations involving position attack and defence phase and transition attack (12.1). In accordance with that, the most useful are the contrasted models which contain two transition and one position phase on each side. Four-phase combinations with no repetition contain the same phases, but in different orders, thus their significance ponder is the same. In nominally equally valued combinations, we should focus on the one which best follows the natural game course, i.e. position defence-transition attack – position attack-transition defence. In combinations with repetitions, with the given limitations, the most useful one is the combination transition defence-position defence – transition attack-transition defence (17.67), followed by combinations of double transition attack and defence (17.66), position defence – transition attack – transition defence-position defence (17.57) and transition defence-position defence – transition attack-position defence (17.57). The least significant combination is the one with position attack-position defence – transition attack-position attack (15.47) and the combination with double position attack and defence (15.48). In contrasted models, the highest total ponder is the combination with double transitions (35.32), and the lowest one the combination with double positions (30.96).

Discussion

Natural phase course in a match is the following: position defence, transition attack, position attack and transition defence. Basic tactic playing model of every trainer should be a quality and efficient position defence developing into fast transition attacks which may become position ones, followed by fast transition attacks which may become position attacks and then transition as fast as possible into position defence (Meletakos, Vagenas, & Bayios, 2011). In accordance with research results, it is evident that result efficiency determines the performance efficiency of certain game phases to a larger extent than numerosity itself, except when it comes to transition attack phase. Result efficiency is primarily achieved by a great number of fast uninterrupted attacks, particularly counter attacks, while long discontinuous activity during position attack is not advisable (Rogulj, 2003).

Attack finalization efficiency on unorganized, compared to the set opponents' defence, is significantly higher due to a lower defence influence and favourable physics conditions for attack finalization, particularly with relation to distance and a more convenient shooting angle. It is logical to assume that the reason for performing more transition attacks in winning teams is the higher level of the players' anthropological potential (Milanese, Piscitelli, Lampis, & Zancanaro, 2011), particularly in speeding force and endurance which are dominant in performing this sort of attack (Bautista et al., 2016; Wagner, Fuchs, & von Duvillard, 2018). Thus it is evident that result efficiency is more determined by transition than position phases, particularly in defence. Long discontinuous position attack activity marked by numerous interruptions most frequently reflects players' limited anthropological potentials in low-quality teams which are striving to compensate it by more frequent and versatile tactics activity during position attack on a set defence (Prieto, Gómez, & Sampaio, 2015; Rogulj, 2009). However, is it possible to perform only fast attacks throughout the game? In theory yes, while in practice there are certain energy limitations in addition to consequences due to a large number of lost balls caused by technical errors. Thus we primarily need to train the natural course of the game by playing strong and dynamic position defence developing into fast transition. Unless the fast transition does not finish positively, and the ball remains in possession, we proceed with the attack position. After the positive or negative ending of this phase, we reach the most important one, which is fast transition into defence. During a training, unlike during a match, we can repeat certain phases which are more useful regarding result within natural course, thus it is logical to use the following model: position defence-transition attack – transition defence-position defence, or particularly this one: transition defence-position defence – transition attack-transition defence. The results of research reveal combinations which, in the experts' opinion, but also according to marked quantitative indicators at a match, determine result efficiency to a larger extent and thus deserve to be dominantly represented during a training process. The purpose of this kind of training should definitely be analysed in future longitudinal researches to establish result-competition efficiency of teams subjected to training procedures based on different phase combinations.

Conclusion

Contemporary training process, particularly in top sport, is greatly marked by intensification and integration principles. The given training time is to be used as effectively as possible. Thus, in sport games, a trainer's practice needs to involve knowledge on efficiency, result significance and kinesiological specifications of certain time units, i.e. game phases. This research is trying to focus on analysing the importance of game phases in handball by applying different methodological approaches. Regarding the significant balance between obtained results, they can also be purposefully used to improve tactical preparation, training process and the competitive approach to a match.

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