

VARIABILITY IN PERFORMANCE INDICATORS OF THE NETHERLANDS WOMEN'S NATIONAL HANDBALL TEAM AT THE 2019 WORLD CHAMPIONSHIP

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Abstract:

The primary objective of this study was to discover the positional attack performance indicators of the winning Netherlands women's national handball team during the 2019 World Championship in Japan. An ideographic, follow-up and multidimensional observational design was used to record and analyse positional attacks disputed in equal numbers of players (6v6) excluding attacks with an empty goal. Polar coordinates allowed us to determine behaviour patterns as well as performance indicators related to attack continuity, situations used to destabilise the opponents' defence, and actions involved in completing the attack. Two levels of analysis were used: each match individually and all the team's matches as a whole. Results show that each match had its own specific game dynamics as different behaviour patterns were activated and different performance indicators were observed depending on the match. These findings highlight the variability and dynamic nature of the offensive behaviours and performance indicators of the world champion team, emphasising the need to study performance indicators with research projects that respect that they are specific and changing.

Key words: *match analysis, behaviour patterns, polar coordinates analysis*

Introduction

Performance indicators are diverse variables; examples of these are technical, tactical or strategic aspects which are associated with achieving sporting success. They not only report variables that facilitate winning a specific match or championship, but also shed light on successful behaviours in the different phases of the game (Higham, Hopkins, Pyne, & Anson, 2014). Performance indicators therefore set winning teams apart from the rest, creating performance profiles that athletes aspire to. In handball, access to performance indicators has provided valuable information on the game dynamics in a given championship or on the evolution of the game, after comparing data from different championships (Prieto, Gómez, & Sampaio, 2015).

Obtaining performance indicators is therefore of great interest to coaches and researchers. Two research approaches can be differentiated when reporting on performance indicators in handball: static and dynamic (Prieto, et al., 2015). The static approach is the most common and also the least complex; it only analyses some actions during the

match, mainly when a team loses the ball, such as shots and turnovers. Static research is based on the analysis of data obtained at the end of one or more matches, being used in other team sports such as basketball or volleyball (Sampaio, Ibáñez, & Lorenzo, 2013). It mainly analyses behaviours of different teams competing in the same championship, whether the men's world championship (Gruic, Vuleta, & Milanović, 2006; Ohnjec, Vuleta, Milanović, & Gruic, 2008; Srhoj, Rogulj, Padovan, & Katic, 2001; Vuleta, Milanovic, & Sertic, 2003), Olympic Games (Montoya, Moras, & Anguera, 2013) or European leagues (Rogulj, Srhoj, & Srhoj, 2004). Also, some studies using this approach also compare performance indicators obtained from different championships (Meletakos & Bayios, 2011; Meletakos, Vagenas, & Bayios, 2011; Volossovitch, Dumangane, & Rosati, 2010). Nevertheless, scientific knowledge regarding women's elite team handball demands is limited, highlighting an important review of the physical and physiological characteristics related to women's team handball players' performance (Manchado, Tortosa-Martínez, Vila, Ferragut, & Platen, 2013).

Research projects carried out using the static approach have paid a lot of attention to completing of attacks; they focus on analysing what happened, paying little attention to how it happened. Consequently, some elements with a decisive influence on game development (score, playing time, opponent actions, tactical means used, etc.) are not taken into account (Sampaio, et al., 2013).

Differently, the dynamic approach pays more attention to game context (Prieto, et al., 2015), studying some elements that decisively condition actions such as systems of play (Lozano, Camerino, & Hilenó, 2016), players on the court at a particular time (Flores & Anguera, 2018) or the result and playing time. Behaviours of players are also studied in chronological order to ascertain changes in game dynamics during a match (Lames, 2006; Lames & McGarry, 2007; Russomanno, et al., 2021). Research conducted according to the dynamic approach has used different tools: sequential analysis, polar coordinates analysis, probabilistic analysis and even neural networks.

Whether using a static or dynamic approach, most research projects offer a stable, fixed image of performance indicators, a general rule that winning teams always meet. Furthermore, performance indicators have mainly been obtained by mixing data from multiple matches played with different teams (Lames & McGarry, 2007). This can present certain problems. Firstly, this type of performance indicator does not respect the emerging, dynamic nature of actions in handball. The sport is developed in contexts of great uncertainty, where players rarely face the same situation twice due to complex interactions between the elements present (Balagué & Torrents, 2011). Behaviours of a team in attack are specifically conditioned by multiple elements, for example: characteristics of players, the use of certain game-play systems, the opponent defence system, style of actions at a given time, refereeing style, the score or playing time (Martins, Mesquita, Mendes, Santos, & Afonso, 2021). These factors can also change during a match and throughout a championship. Therefore, considering performance indicators as fixed and stable can be at odds with the dynamic reality of the game. On the other hand, obtaining performance indicators that are equally valid for all teams can be a difficult task: Do all teams have the same ability to take long-range shots, to play with a line player, or to score from the wing? Specific performance indicators must be found for each team, ones which also respect the specific nature of each match (Laporta, et al., 2021).

Likewise, the study of performance indicators must also be consistent with the variability inherent to the actions performed during handball games. That variability is expressed as the ability to adapt a given action to unforeseen changes that occur in a sporting context and as the ability to solve the

same game situation in a different way (Correia, Carvalho, Araújo, Pereira, & Davids, 2018). In fact, variability in attacking behaviours is a characteristic of teams that perform well (Correia, Bastos, Silva, Clavijo, & Torriani-Pasin, 2020).

For this reason, the primary objective of this study was to discover the positional attack performance indicators of the winning Netherlands women's national handball team during the 2019 World Championship in Japan. Behaviour patterns carried out specifically in each match and also during the overall championship were therefore analysed.

Methods

This study was conducted according to the follow-up/ideographic/multidimensional (F/I/M) observational design (Anguera, Blanco-Villaseñor, Hernández-Mendo, & Losada, 2011): (a) ideographic because behaviour of different handball players was studied who, as members of the same team, worked as a unit; (b) follow-up because various matches were analysed, and also an intra-session follow-up during each match that contributed the frequency and sequence of the behaviours recorded; and (c) multidimensional because several response levels, collected using the observation instrument, were studied.

Participants

Six matches of the Netherlands national team, winners of the 2019 Japan Women's World Handball Championship, were analysed: preliminary round matches: Netherlands—Serbia and Netherlands—Norway; main round matches: Netherlands—Germany and Netherlands—Denmark; the semi-final match: Netherlands—Russia; and the final match: Netherlands—Spain. In total, six out of the ten matches played by the Netherlands national team during the championship were analysed.

The study was conducted in accordance with the ethical principles set out in the Declaration of Helsinki and in accordance with the Belmont Report (1978); neither informed consent nor a review by the relevant ethics committee were necessary since: (a) the study involved observing people in a public setting (sports facility); (b) the people and groups observed had no reasonable expectation of privacy (matches were broadcast around the world); and (c) the study did not involve any intervention by researchers or direct interaction with the individuals studied.

Instruments

Observation instrument

An *ad-hoc* observation instrument was created (Table 1) in order to record the most relevant behav-

hours in relation to the objectives proposed. A design was chosen that combined the field format with comprehensive and mutually exclusive category systems. This combination leveraged the strengths of both instruments; category systems offer theoretical consistency, while the field format lends flexibility when recording the specific behaviours to be studied (Anguera & Hernández-Mendo, 2013).

The observation units were the positional attacks of the Netherlands national team disputed in equal numbers of field players (6v6), excluding attacks with an empty goal. Positional attack and fast break are the two offensive phases of handball. A positional attack is organised and played against an organised defence. Therefore, each observation unit began at the beginning of the positional attack and ended when the Netherlands team lost the ball (due to a shot taken or a turnover) or following a

referee's decision with no change in possession, such as a free throw or throw-in (Lozano, et al., 2016).

The observation instrument was developed in three phases. (1) Two national handball coaches with prior experience in observational studies created an initial version in order to collect the most important behaviours in the different sub-phases of the positional attack: beginning, development and completion (Gruic, et al., 2006; Montoya, et al., 2013). (2) The instrument was then subjected to a caution test (Anguera, 2003), which consisted of recording three matches not included in the sample. This test was used to either add, amend or eliminate criteria and categories from the initial version of the instrument. The caution test was considered passed when no new behaviours were detected in any criteria. (3) The instrument was judged by five experts, univer-

Table 1. Observation instrument

Criteria	Categories
Number (NUM)	Six against six (6v6) / seven against six (7v6) / six against six with empty goal (E6v6) / six against five (6v5) / six against five with empty goal (E6v5) / other (XvX).
Defensive System (SDF)	Defensive system used against the attack: 6:0 (SIX) / 5:1 (AVN) / 4:2, 3:3 or man marking (ABI) / mixed defence (MIX).
Offensive System (SAT)	3:3 offensive system (T33) / One wing moves from its position to the second line player (DEX) / left, right or centre back leaves its position to play as a line player (T24).
Sequence (SEC)	A new sequence begins when play is interrupted (for example, a free throw is called) and possession is not lost: first sequence (SQ1) / second sequence (SQ2) / third sequence (SQ3) / fourth sequence or more (S4M).
Type of main attack (TAF)	A situation involving two or three players trying to destabilise the opponent defence (Figure 1): 2v2 centre back-line player, with the line player between the left and right middle defenders (A34) / 2v2 centre back-line player, with the line player between the middle and half defenders (A45) / 2v2 left or right back-line player, with the line player between the half and middle defenders (A23) / 2v2 left or right back-line player, pairing the line player with the outside defender (A12) / 2v2 left or right back-line player, with the line player between the half and outside defenders (A22) / a situation played by the centre back, left or right back and line player positions, after the wing has moved to the line player position (CLP) / 1v1 by the left or right back with the line player between the middle defenders (LPA) / 3v3 by the left or right back and two line players (LPP) / attempting to destabilise the opponent defence with a situation other than the above (OTR).
Place of main attack (LAF)	Place where team tries to destabilise the defence: left attacking area (ZIZ) / right attacking area (ZDE) / centre (ZCN).
Main attack player (JAF)	A player involved in destabilising situation: number 18 (N18) / number eight (N08) / number nine (N09) / number 79 (N79) / number six (N06) / number 5 (N05) / other (NIN).
Number of passes after the main attack (PAF)	The number of passes after the destabilisation and before the completion: from zero to one pass (P01) / from two to three passes (P23) / four or more passes (P4M).
Crosses and/or swaps after the main attack (XAF)	The number of crosses during the attack, either to destabilise the defence or after it has been completed: zero (X00) / two (XP2) / three or more (X3M).
Place of completion (LFI)	Area where attack is completed: left attacking area (FIX) / right attacking area (FDE) / centre (FCN).
Completing player (JFI)	First line player who completes attack or gives an assist to the winger or line player: number 18 (F18) / number eight (F08) / number nine (F09) / number 79 (F79) / number 6 (F06) / number five (F05) / other (FOT).
Completion action (AFI)	Individual action that completes the attack: action by the line player (PIV) / action by the winger (EXT) / fake or penetration by the first line player (J6M) / a long-range shot or action around the nine-metre line (J9M).
Attack outcome (DFI)	Attack ending in: goal scored, penalty throw or two-minute suspension for a defender (G72) / missed shot (MIS) / turnover (PER) / free throw or other interruption of play with no change in possession (NOL).

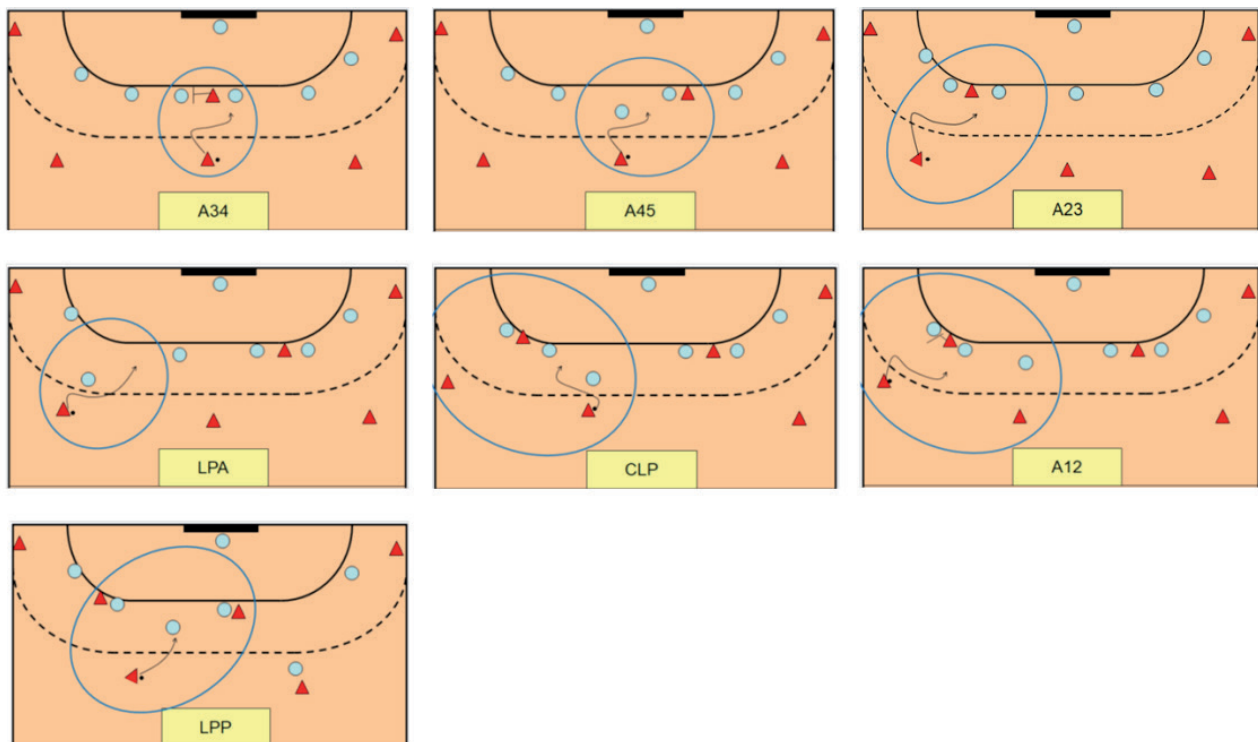


Figure 1. Graphic representation of categories in the 'Type of main attack (TAF)' criterion.

sity handball teachers and national coaches. They filled in a rating template indicating whether they agreed or disagreed with each criterion and category. Finally, all criteria and categories included in the observation instrument achieved a rating of 80% or more, i.e., at least four of the five experts approved them. The final observation instrument consisted of 13 criteria and 60 categories.

Recording instruments

The observation instrument was entered into the Dartfish 5.5. program in order to record and code actions; this software was therefore used as the recording instrument. The polar coordinates analysis was applied using HOISAN 1.2 software (Hernández-Mendo, López, Castellano, Morales, & Pastrana, 2012). Prior to calculating polar coordinates and as a prerequisite, a sequential lag analysis was performed using GSEQ 5.1 software (Bakeman & Quera, 2011); +1 to +5 were considered positive lags for the prospective perspective, and -1 to -5 for the retrospective perspective. Finally, after completing the polar coordinates analysis, significant associations were represented graphically using Snowflake 0.2.

Procedure

Actions were recorded and coded by two observers, handball coaches with experience in observational methodology. Both took part in creating the observation instrument, had experience in observational studies, and were familiar with the recording instrument. To optimise the

reliability of their observations, the observers took part in a training process in which they recorded matches not included in the sample. The training process ended when concordance levels over 0.80 in Cohen's Kappa statistic were obtained for all criteria, both at the intra-observer level (a single session recorded by the same observer at two different times 18 days apart), and at the inter-observer level (a single session recorded by the two observers). After the training phase, behaviours in each of the six matches included in the study sample were recorded and coded. Intra- and inter-observer concordance levels were calculated; in both cases a Cohen's Kappa index of over 0.95 was obtained in all criteria. According to Landis and Koch (1977, p. 165), the level of agreement in both tests can be considered 'almost perfect'.

Data analysis

A polar coordinates analysis offers information on behaviour patterns that emerge during the match. This analysis is used in team sports research studies (Castañer, et al., 2016). This analysis means that activation and inhibition associations in the behaviours studied can be represented in graphic form. The behaviours analysed in the polar coordinates analysis take on two roles: focal behaviour, considered to be the generator of relationships, and conditioned behaviour, which are all other behaviours analysed.

A prospective and retrospective lag sequential analysis must be conducted prior to calculation. The same number of lags in both perspec-

tives is considered, from 1 to 5 for prospective and -1 to -5 for retrospective. The prospective perspective reports on conditioned behaviours that are activated or inhibited after the focal behaviour has been performed. In turn, the retrospective perspective reports on conditioned behaviours that activated or inhibited the appearance of the focal behaviour (Anguera, et al., 2011).

After completing the prospective and retrospective sequential analyses, the polar coordinates analysis integrates them using Zsum statistic (Sackett, 1980), a powerful data reduction technique. Each prospective and retrospective Zsum can be either positive or negative. Thus, the combination of signs (+ or -) will determine in which of the four possible quadrants (I, II, III, IV) to place significant associations, those with a radius greater than 1.96 ($p < .05$), between the focal behaviour and conditioned behaviours. Quadrant I indicates a mutually activating relationship between focal and conditioned behaviours; quadrant IV indicates that the focal behaviour activates the conditioned behaviour, yet is inhibited by it; quadrant III shows a mutually inhibiting relationship between the behaviours; and finally, quadrant II points to the focal behaviour inhibiting the conditioned behaviour, while the conditioned behaviour activates the focal behaviour (Anguera, et al., 2011).

Results

Figures 2 and 3 and Tables 2 and 4 show the results obtained after the polar coordinates analysis. Each figure has seven polar coordinates maps that represent significant associations between the focal and conditioned behaviours, one for every single match analysed plus another one that shows the analysed records from the six matches as a whole. Figure 2 shows the behaviour patterns that emerged during attacks in equal numbers with six attackers against six defenders. Therefore, the 6v6 category acted as the focal behaviour while the conditioned behaviours were the rest of the categories of the observation instrument. Associations in quadrants I and IV are represented, i.e., behaviours activated by the focal behaviour. Figure 3 shows the performance indicators, therefore the union of 6v6 and G72 categories acts as the focal behaviour and the other behaviours in the observation instrument are conditioned. Associations in quadrants I and II are represented to ascertain which behaviours took place first and activated offensive success, in attacks developed in equal conditions with six attackers against six defenders.

Behaviour pattern analysis

In Figure 2, the seven maps show how positional attacks with six attackers against six defenders activated (quadrants I and IV) different behav-

iours related to main attacks and completions. In relation to main attacks, in match Netherlands—Serbia were activated: A23 (2v2 left or right back-line player), LPA (1v1 from the left or right back) and LPP (left or right back attacks with two players at the line player), as well as those right attacking area (ZDE); in match Netherlands—Norway were activated A23 and A45 (2v2 centre back-line player, with the line player between the central and half defenders); in match Netherlands—Germany A23; in Netherlands—Denmark A34 (2v2 centre back-line player, with the line player between the central defenders), A45 and LPP (3v3, with the left or right back and two players in the line player position); in the semi-final match Netherlands—Russia: A45; and in the final match Netherlands—Spain situations A34, CLP (centre back, left or right back and line player playing 3v3 after the wing has moved to the line player position) and LPP were activated. Finally, when the records from all the matches are analysed as a whole, the main attacks A45, LPA, CLP, and LPP were activated.

Regarding completions, in Netherlands—Serbia were activated: completions from the centre (FCN), by the line player (PIV) and by player number 18 (F18); in match Netherlands—Norway completions from the right attacking area (FDE); in match Netherlands—Denmark completions from the central attacking area (FCN); in the semi-final match Netherlands—Russia completions from the centre (FCN) and attacks with two or three passes after the main attack (P23). In the final match Netherlands—Spain were activated: completions from the central attacking area (FCN), from the nine-metre line (J9M) and from six metres (J6M). Finally, when the records from all matches are analysed as a whole, completions from the centre (FCN), by the line player (PIV) and completions involving player number 79 (F79) were activated.

Performance indicator analysis

The behaviours firstly performed that activated success (quadrants I and II) were different in each match. In match Netherlands—Serbia: attacks against a 5:1 defence (AVN) and main attacks LPA and A12 (2v2 pairing the line player with the outside defender). In match Netherlands—Norway: attacks against a 6:0 defence (SIX), main attack A23 and attacks with two or three passes after the main attack (P23). In match Netherlands—Germany there were no behaviours that significantly activated success. In match Netherlands—Denmark: main attack A34 and completions involving players number six (F06) and number five (F05). In the semi-final match: main attacks by player number eight (N08), attacks with no cross or swap (XP0) and attacks with a maximum of one pass after the main attack (P01). In the final match: attacks using the 3:3 system from start to end of the positional

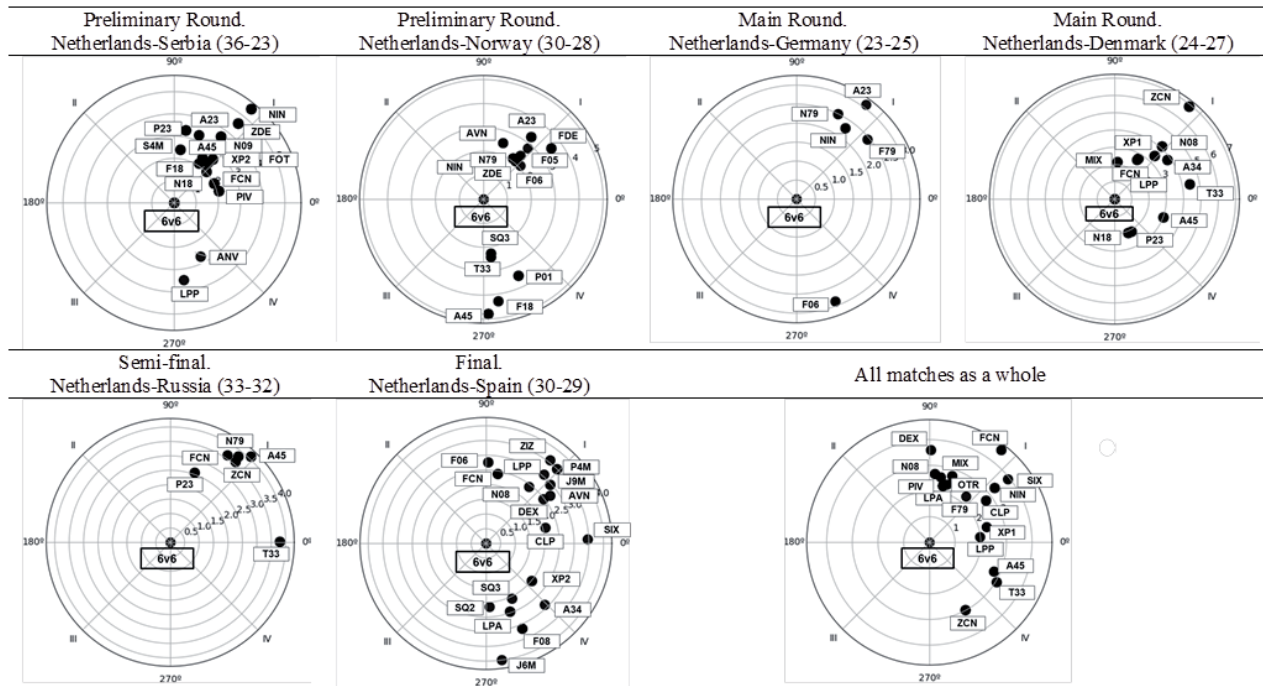


Figure 2. Behavior patterns analysis.

Table 2. Behaviour patterns analysis

Preliminary Round. Netherlands-Serbia (36-23)				Preliminary Round. Netherlands-Norway (30-28)				Main Round. Netherlands-Germany (23-25)				Main Round. Netherlands-Denmark (24-27)			
C.	Q.	R.	A.	C.	Q.	R.	A.	C.	Q.	R.	A.	C.	Q.	R.	A.
S4M	I	2.42	83.61	AVN	I	2.49	70.76	NIN	I	2.27	55.54	MIX	I	2.19	85.52
A23	I	3.24	70.01	A23	I	3.29	52.56	N79	I	2.50	64.27	T33	I	4.44	11.44
A45	I	2.35	50.08	N79	I	2.13	54.30	A23	I	3.10	53.73	A34	I	3.81	36.69
N18	I	2.02	44.18	NIN	I	2.09	49.89	F79	I	2.45	40.14	LPP	I	2.73	59.98
N09	I	3.65	54.73	ZDE	I	2.38	50.00	F06	IV	2.87	290.98	N08	I	4.11	47.94
NIN	I	5.46	50.55	FDE	I	3.56	37.12					ZCN	I	6.88	51.43
ZDE	I	4.61	51.21	F06	I	2.09	42.86					XP1	I	3.42	47.47
XP2	I	2.62	48.28	F05	I	2.84	49.19					FCN	I	2.63	61.09
P23	I	3.31	81.00	F18	IV	4.28	278.23					A45	IV	3.01	339.77
PIV	I	2.08	15.26	T33	IV	2.41	277.61					N18	IV	2.10	291.37
FCN	I	2.00	26.15	SQ3	IV	2.27	277.97					P23	IV	2.11	297.61
F18	I	2.09	57.98	A45	IV	4.79	272.34								
FOT	I	2.40	58.12	P01	IV	3.49	294.47								
AVN	IV	2.55	295.95												
LPP	IV	3.49	227.27												
Semi-final. Netherlands-Russia (33-32)				Final. Netherlands-Spain (30-29)				All matches as a whole							
C.	Q.	R.	A.	C.	Q.	R.	A.	C.	Q.	R.	A.	C.	Q.	R.	A.
T33	I	3.79	0.62	SIX	I	3.46	2.57	SIX	I	3.92	38.78	NIN	I	3.31	40.14
A45	I	4.09	46.94	AVN	I	2.72	36.65	MIX	I	2.74	71.11	XP1	I	2.29	15.00
N79	I	3.79	51.76	DEX	I	2.46	37.93	DEX	I	3.60	89.28	PIV	I	2.58	80.24
ZCN	I	3.59	51.26	CLP	I	2.08	14.80	LPA	I	2.26	79.60	FCN	I	4.55	52.17
P23	I	2.57	70.99	LPP	I	3.07	50.08	CPL	I	2.74	36.75	F79	I	2.29	51.44
FCN	I	3.62	56.74	N08	I	2.41	52.88	LPP	I	1.97	6.06	T33	IV	3.04	329.37
				ZIZ	I	3.58	52.54	OTR	I	2.36	73.39	A45	IV	2.75	335.91
								N08	I	2.69	85.82	ZCN	IV	2.98	297.69

Note. C: category; Q: quadrant; R: radius; A: angle

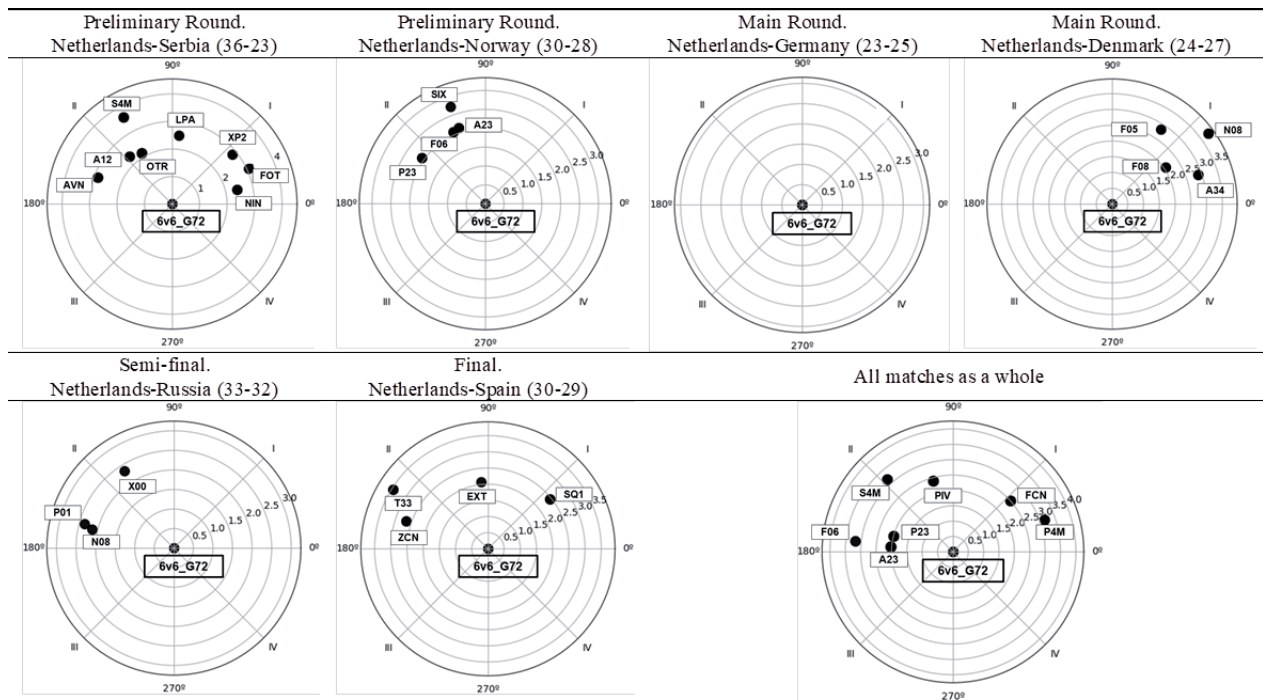


Figure 3. Performance indicators analysis.

Table 3. Performance indicators analysis

Preliminary Round. Netherlands-Serbia (36-23)				Preliminary Round. Netherlands-Norway (30-28)				Main Round. Netherlands-Germany (23-25)				Main Round. Netherlands-Denmark (24-27)			
C.	Q.	R.	A.	C.	Q.	R.	A.	C.	Q.	R.	A.	C.	Q.	R.	A.
LPA	I	2.50	84.19	A23	II	2.13	109.23					A34	I	2.88	18.74
NIN	I	2.43	12.63	P23	II	2.08	144.19					N08	I	3.78	36.35
XP2	I	2.85	39.47	F06	II	2.08	114.30					F08	I	2.06	34.85
FOT	I	3.06	25.03	SIX	II	2.73	109.84					F05	I	2.83	57.07
AVN	II	2.86	160.43												
S4M	II	3.62	119.14												
A12	II	2.16	120.44												
OTR	II	2.32	132.15												
Semi-final. Netherlands-Russia (33-32)				Final. Netherlands-Spain (30-29)				All matches as a whole							
C.	Q.	R.	A.	C.	Q.	R.	A.	C.	Q.	R.	A.	C.	Q.	R.	A.
N08	II	2.15	167.26	SQ1	I	2.45	38.59	P4M	I	3.16	19.30	P23	II	2.00	164.86
X00	II	2.34	122.61	T33	II	3.47	147.99	FCN	I	2.50	42.09	PIV	II	2.40	105.60
P01	II	2.36	164.67	ZCN	II	2.66	161.20	S4M	II	3.18	132.14	F06	II	3.19	173.68
				EXT	II	2.08	95.73	A23	II	2.04	175.34				

Note. C: category; Q: quadrant; R: radius; A: angle

attack (T33), main attacks from the centre (ZCN) and completions from the wing (EXT). Finally, once all the matches were analysed as a whole, the behaviour that activated success were: main attacks A23 and LPA (lv1 on the left or right back), attacks with two or three passes (P23) and attacks with four or more passes after the main attack (P4M), as well as completions from the line player (PIV), in the centre (FCN) and involving player number six (F06).

Discussion and conclusions

The primary objective of this study was to discover the positional attack performance indicators of the winning Netherlands women’s national handball team during the 2019 World Championship in Japan. Behaviour patterns carried out specifically in each match and also overall during the championship were therefore analysed. The results of the

polar coordinates analysis indicated that the Netherlands national handball team achieved success in different ways and with different styles of play, depending on the demands of each match.

Behaviour pattern analysis

The analysis of the records from all the matches as a whole offered information on overall behaviour trends in the Netherlands team during the championship. With regard to the area from which the main attack was carried out, an activation association was found from the centre. However, the picture was different when analysing each match individually: main attacks were activated from the right in the preliminary round matches, Netherlands—Serbia and Netherlands—Norway; from the centre in the main round match Netherlands—Denmark and the semi-final Netherlands—Russia; while main attacks were activated from the left in the final Netherlands—Spain. These results prove that each match had its own play dynamics, in line with the findings of Lames (2006) and Russomanno et al. (2021).

This divergence is repeated when studying the situations used for the main attack. The following situations were activated when analysing all the championship matches as a whole: A45, LPA and CLP. Different results were found when analysing each match independently: situation A23 was activated in the first three matches of the championship, A34 against Denmark, and LPA only in the final against Spain. These diverging results can be explained by the strategic approach to each match. It is logical that the Netherlands coaching team would select the elements of their game model that allow them to exploit the weaknesses of each opponent. The variety of situations used by the Netherlands team to attack 6:0 defensive systems reinforces the findings of Laporta et al. (2021) when they claimed that teams can be successful using different ways of playing.

Attack completion was less variable as completions were activated from the centre in four out of the six matches. These results coincide with Srhoj et al. (2001), in his research on the 1999 Men's World Handball Championship, who pointed out that the most frequent completions were from the centre of the attack. The use of main attack LPP (left or right back and two line players playing 3v3) could also be considered a team behaviour trend when the opponent uses a 5:1 defensive system as this type of main attack was activated in both matches where this defensive system was used. In view of the results, it seems that the Netherlands team shows greater variability in its offensive behaviours when facing the 6:0 defensive system than against the 5:1 system.

Regarding behaviours related to attack completion, all the matches analysed as a whole showed completions involving player number 79 and

completions from the line player position. The results were different when analysing each match individually. Completions from 9 metres and from the 6-metre line were activated in the final, behaviours not activated in any other match. This criteria also shows that the development of each match is different. Therefore, in line with Lames and McGarry (2007), the usefulness of performance indicators obtained from analysing matches as a whole can present some problems.

Performance indicator analysis

As for performance indicators, different behaviours were found related to attack continuity (expressed as the number of passes after the main attack), main attacks and completions activating success. As with behaviour patterns, two types of analysis were conducted: each match individually and all the matches as a whole. The joint analysis found that attacks with two or more passes after the main attack activated success. This does not match the findings of other research (Rogulj, et al., 2004; Vuleta, Sporiš, Purgar, Herceg, & Milanović, 2012), which indicated that winning teams completed short positional attacks. In our research, this is only true in the championship semi-final where success was activated by attacks with a maximum of one completed pass.

In relation to main attacks, joint analysis of records from all the matches found that situation A23 activated success in attack. The same result was found in only one match (Netherlands—Norway) when analysing each match individually. In the Netherlands—Serbia match, situations A12 and LPA acted as performance indicators, while it was A34 in Netherlands—Denmark. These results highlight two issues: (1) the importance of playing with the line player to destabilise the opponent defensive system, in line with Meletakos et al. (2011); and (2) the variety of situations used by the Netherlands national team to destabilise the opponent defence associated with success.

Completions from the centre were associated with success when all the matches were analysed as a whole. The joint analysis also found that completions by the line player came before offensive success, in line with the findings of other studies that emphasise the effectiveness of shots from the six metres in the centre (Srhoj, et al., 2001). As with other performance indicators, these results were not observed when matches were analysed one by one. For example, completions from the wing activated success in the final, coinciding with other research studies (Montoya, et al., 2013; Vuleta, et al., 2003) that associated completions from the wing with winning teams. However, the Netherlands team did not show this result in any other championship match. In this criterion, the Netherlands national team also shows variability in their behav-

behaviour typical of elite athletes (Correia, et al., 2020).

Although most research papers on handball have offered fixed and stable performance indicators, this paper has verified that the world champion team does not play in the same way throughout the championship and that its performance indicators vary with each match. It seems logical that the Netherlands national team, and any other team, would change elements of its game model and strategy depending on the demands of each match: to exploit opponent team weaknesses, to surprise and deactivate the opponent's strategy, or due to injuries, penalties or changes in player fitness (Martins, et al., 2021). Therefore, in line with Lames and McGarry (2007), the usefulness of performance indicators obtained by jointly analysing various matches can be problematic as the dynamic and variable characteristics of the sport cannot be reflected. Furthermore, if a given behaviour or game situation is associated with success, this does not mean that it should be repeated continuously, as there is a risk of attacks becoming predictable and helping the defence. This highlights the non-linearity of sport (Balagué & Torrents, 2011) and, therefore, of performance indicators: a behaviour that led to success in one match may not have the same effect in another, not even in another match against the same opponent as the opponent team may change aspects of its defensive system to counteract them. Likewise, some behaviours that did not initially lead to success may later do it after some adjustments have been made.

Performance indicators obtained after analysing the behaviours of different teams as a whole, in one or more championships, have also served to understand general trends in play at a given time, to understand the effect of any change in regulations, or to observe how the pace of play gradually increases (Meletakos & Bayios, 2010; Volossovitch, et al., 2010). However, for performance indicators to help coaches in their day-to-day, whether to fine tune the design of training programmes or to strategically prepare for a competition, they must be specific to a team. The ecological perspective and from the theory of non-linear dynamic systems help us to understand that, depending on their characteristics and the other elements that condition the game, teams organise themselves in a certain direction, performing the behaviours that are successful for them (Balagué & Torrents, 2011). Consequently, a game-play model design, training process planning and preparation for a competition are specific and original processes for a given team. Behav-

our pattern and performance indicator analysis can help to prepare these processes, with information on behaviours in certain situations during the competition (what behaviours are displayed against a 5:1 defensive system, what actions are carried out when the referees threaten to call passive play, what strategies are used at the end of a match with a tied score, etc.). Moreover, not only technical, tactical and strategic performance indicators must be specific but also performance indicators related to physical training as implementing a certain game model has its own demands, different from other game models.

In relation to the objective of this study and taking the results obtained into account, the following conclusions can be drawn:

- The Netherlands national team does not play the same way throughout the championship, varying its behaviours depending on the match.
- Performance indicators are dynamic and variable behaviours; they change according to the match analysed.
- The practical usefulness of performance indicators obtained from analysing various matches together is in doubt.
- Most situations used to destabilise the opponent defensive system include the line player.
- Situations used to destabilise the 6:0 defensive system are more variable than those used against the 5:1.
- Some behaviours offer great stability: completions from the centre.

Although this study provides valuable information on the variability of attacking behaviours and performance indicators of the world champion team, it does have some limitations. It cannot analyse the intrinsic dynamics of each match and, therefore, understand changes in strategy during the match. Nor does it analyse behaviours according to which players are on the court at a given time and occupy key positions, such as the centre back (Flores & Anguera, 2018). Furthermore, the study of behaviour patterns and performance indicators did not take into account the influence of prior actions. If we imagine that during a given match the last two attacks have ended with a pass to the line player, during the next attack, the defence is likely to try to fall back to protect against this action, assuming the risk of conceding a long-range shot. Taking these aspects into account could help future research studies aiming to delve deeper into the variability inherent to performance indicators in handball.

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