



Mixed Methods in Decision-Making Through Polar Coordinate Technique: Differences by Gender on Beach Handball Specialist

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The aim of this research was to analyze decision making of the specialist in beach handball in the framework of mixed methods, and through the observation of their actions. To do this, and distinguishing it by genre, an analysis of polar coordinates was realized using the assist and completion of this specific position as behavior criteria. A total of 24 sessions were observed with the HOISAN computer software, using an *ad hoc* design tool. Observation design used was nomothetic, punctual, and multidimensional. The obtained results showed significant relations between the behavior criteria and conditional behaviors (pairing), showing significant relations different for male and female categories. Significant differences were estimated statistically about the importance of the specialist in the development of the static attack in beach handball and their influence in the final result of the match, based on their greater or lesser success in decision making. In the male category it is highlighted that the specialist's assists are not positively related to a favorable score and that the attack usually ends up in the central areas against closed defensive systems; in addition, their successful completion decisions are produced by means of launches in the central zone, also against closed defensive systems; however, in the female category, specialists' assists lead to end the attacks in flight on the far right against open defensive systems.

Keywords: mixed methods, systematic observation, decision making, polar coordinates, beach handball

INTRODUCTION

The available literature has brought to light how in collective sports there has been a progressive increase in the physical, technical and tactical demands of competition in recent decades (Carling, 2011; Sarmiento et al., 2017). This has generated the necessity of increasing the specific knowledge about these aspects to be able to plan training sessions properly and make a better preparation of the team (Nunes et al., 2015).

Beach handball is not unaware of this situation, as shown by the evolution developed in the modality in all aspects of the game since its inception in the 1990s to the present (Morillo-Baro and Hernández-Mendo, 2015), generating the need for continuous updating and innovation in

the professionals of this sport. In the last years, it has undergone a very significant increase, due to the investment that the corresponding sports institutions have made in this sport: European handball federation (EHF), international handball federation (IHF) and the respective national federations developing championships at the state, continental and world level, both of clubs and of the respective national teams (Zapardiel Cortés, 2015).

This modality presents substantial differences with the handball court, both at the regulatory level and in the different facets of the game, turning it into a very new modality, which has successfully broken into the national and international scene. Its own rules of the game make it very attractive, uncertain and interesting (Belančić, 2005). One of the main differences is the way of scoring depending on the different actions: one-point goals can achieve by a classic launch from any player other than the goalkeeper-specialist, or two-point goals can be scored by spin shot of 360-degree, flight shots or by the specialist's shots (Ostoić and Ohnjec, 2015).

The situation of numerical superiority of the opposing team by means of the defense-attack change of the goalkeeper by the specialist gives him a decisive role in the creation of the offensive game (Gruič et al., 2011). When the game is always developed in offensive numerical superiority, and the possibility of this player to score a two-point goal through a classic shot, makes the player a focus of attention from the defenders of the opposing team. This aspect generates spaces that can be used by teammates through an individual action or an assist. These tactical considerations turn the position of the specialist into one of greater responsibility in decision-making, as the analysis of the international competitions held show (Tezcan, 2013).

The decision making is one of the main heuristics in sports practice, it is defined as the process by which the athlete decides how to act or react according to the demands of the environment to achieve different performance objectives (Hodges et al., 2007); in short, it is about guessing the right information from the environment to plan future actions. In recent years, the study of the decision-making process in collective sports has received considerable attention; in football, it has studied the influence of contextual factors on decision-making by highly skilled players through semi-structured interviews, where the importance of considering the dynamic and static context in which players make decisions was demonstrated (Levi and Jackson, 2018); in volleyball, the relationship between decision-making and performance in three actions of the game (reception, scenario, attack) has been analyzed, through which, it was clear that the relevance of the decisional skills in the performance of the actions of the game, which contribute to the final performance of equipment (Conejero et al., 2018); a study made with players from NFL and NCAA about the theory of the risk sensitivity showed that athletes risk-sensitive decisions were made when the needs motivational interviewing were stronger (Gonzales et al., 2017); finally, in handball, players have been studied, showing the influence of game time for decision-making in relation to tactical media used (Prudente et al., 2017), and the referees, showing how the spatial situation of the same ones influences the success or error (Morillo-Baro et al., 2017b).

And in beach handball, the influence of different contextual factors on decision-making by players in competition has been analyzed (Vázquez-Diz et al., 2019a).

Araújo et al. (2016) propose to study the process of decision making, based on the ecological perspective, observing the trace or behavioral traces of athletes through success patterns against unsuccessful patterns considering different factors such as space, teammates and rivals. The observation of this trace of behavior can be done through a mixed observation tool of Field Format and Category Systems E/ME (exhaustive and mutually exclusive) (Araújo et al., 2016). Systematic observation is a technique and/or methodology to analyze behavior in sports (Anguera and Hernández-Mendo, 2013) and several tools have been created to analyze what happens in the situations of game of handball (González, 2012; González et al., 2013; Sousa et al., 2014; Loffing et al., 2015; Helm et al., 2016; Jiménez-Salas and Hernández-Mendo, 2016) and beach handball (Morillo-Baro and Hernández-Mendo, 2015; Vázquez-Diz et al., 2019b).

Studies in the field of sport, in the framework of mixed methods, need to connect qualitative and quantitative elements (Plano-Clark and Sanders, 2015), and the ideal solution is to apply the successive steps defined within systematic observation, that is the main procedure to collect sport data in event analysis and there is ample experience with its use and evidence of its potential (Portell et al., 2015). Also, systematic observation is widely applicable and offers an optimal balance between rigor and flexibility. The observational records are qualitative, but the quantizing (Tashakkori and Teddlie, 1998) is particularly robust, because apart from simple frequency counts, it contemplates other essential primary parameters, such as order and duration. This specific consideration of the order parameter is crucial for detecting hidden structures through the quantitative analysis of relationships between different codes in systematized observational datasets (Anguera et al., 2017). Just the wide scope of opportunities available for processing data derived from observation supports the idea that purely observational studies should be considered as mixed methods research studies, even though they constitute a somewhat special case and do not follow traditional patterns (Anguera et al., 2017).

Systematic observation is developed in natural or habitual contexts, and consists in a scientific procedure that, based on the considered objectives, reveals the occurrence of perceptible behaviors, to proceed to its registration organized by means of a specifically elaborated instrument and using the appropriate parameters. The motor behavior can be studied through the most characteristic analysis of the observational methodology, the sequential analysis of delays and the polar coordinate analysis (Anguera and Hernández-Mendo, 2013, 2014, 2015). The sequential analysis of delays is aimed at the detection of sequential patterns of behavior and is carried out by means of the search of sequential contingencies between categories or codes of behavior, through an observation instrument configured through a system of categories, field format or mixed instruments between category system and field format (Anguera et al., 2007).

Taking into account all this background on beach handball as an object of study, the aim of this research has been to observe the decision making of the specific position of the specialist through

the observation of their actions. Identify, for each gender, the different significant associations between the behaviors of this specific position and those of the rest of the observation tool by analyzing polar coordinates.

MATERIALS AND METHODS

In the framework of mixed methods, the observational design used was nomothetic, punctual and multidimensional (Anguera et al., 2011). The unit of observation was the sequence of positional attack, which in this investigation will be defined from when the figure of the specialist appears in the attack until the change of possession occurs.

Participants

Of the 24 teams that participated in the 2016 Senior Spanish Cup, six teams of each gender were selected to be observed ($M \pm SD$: age male = 26.67 ± 5.85 ; age female = 23.27 ± 5.74). The six teams have been selected randomly. The research was conducted on a total of 24 observation sessions, twelve for the male category and twelve for the female category. The number of sessions estimated to generalize accurately (Morillo-Baro et al., 2015). **Table 1** shows the matches that have been analyzed.

Instruments

The Royal Spanish Handball Federation (RFEBM) recorded the matches. The HOISAN v. 1.6.3.3.2 computer software was used (Hernández-Mendo et al., 2012) to perform the sequential analysis, the polar coordinate analysis and its vectorial representation, as well as the codification of the observations

before to the sequential analysis. An *ad hoc* design tool has been used which has passed the quality tests of the data required in OM, (Morillo-Baro and Hernández-Mendo, 2015). It is built through a mixed system of field formats and exhaustive and mutually exclusive category systems (E/ME). The tool consists of 11 criteria and 90 categories that are complementary to the chronological development of an attack (Morillo-Baro and Hernández-Mendo, 2015). **Table 2** shows the composition of the instrument of observation and **Figure 1** the division of game spaces:

Procedure

Data Quality

Once the data collection is done, the observer must have the necessary guarantee about its quality (Anguera, 2003). Pearson's, Spearman's, Tau b of Kendall's correlation coefficients and the Coefficient Phi have been evaluated. In addition, Cohen's Kappa concordance index was calculated for the complete session, the results are shown in the **Table 3**.

Cohen's Kappa index of this research exceeds the score of 0.90 for intra-observer (0.94) and inter-observer (0.91) reliability. Therefore, observing the values of Gelfand and Hartmann (1975) or Landis and Koch (1977), it can be considered that there is a high reliability.

Generalizability Analysis

For the application of the Theory of Generalizability, SAGT computer software has been used (Hernández-Mendo et al., 2016). This software has been used to determine the intra-observer and inter-observer concordance, through a design of two facets, categories and observers = C/O, in addition to assessing the homogeneity of the categories, but this time with a two-faceted design, likewise, but with an O/C design. The Theory of Generalizability unifies the definitions of reliability, validity and precision. The Generalizability study consists basically of four phases: (1) definition of the facets of study; (2) analysis of variance of the scores obtained on the study facets; (3) calculation of the error components; (4) optimization of the Generalizability coefficients (Blanco-Villaseñor et al., 2014).

A two-faceted design (categories and observers = C/O) has been established, as discussed above, to determine the reliability among observers (inter-observer concordance). The results shown by the report obtained through the SAGT program indicate that almost all the variability is associated with the facet categories (97.12%), being 0 for the facet observers and 2.28% for the interaction of the facets categories/observers. The coefficients of generalizability in this design structure determine results of 0.98, which means excellent results.

For the determination of intra-observer reliability, the same design has been taken. The results indicate that almost all the variability is associated with the facet categories (97.99%), being 0 for the facet observers and 2.01% for the interaction of the facets categories/observers. The coefficients of generalizability in this design structure determine results of 0.99, which means excellent results.

To assess the homogeneity of the categories, a two-faceted design has been used (observers and categories = O/C), this

TABLE 1 | Analyzed matches.

Category	Matches
Male	C. BMP. Alcala – Zonabalonmano Cadiz
	C. BMP. Ciudad de Malaga – C. BMP. Bahía de Algeciras (team no observed)
	C. BMP. Ciudad de Malaga – C. BMP. Barbate "B" (team no observed)
	BHC Plan B Barcelona – C. BMP. Barbate
	BHC Plan B Barcelona – Zonabalonmano Cadiz
	Pinturas Andalucía BMP Sevilla – C. BMP. Barbate
	Pinturas Andalucía BMP Sevilla – C. BMP. Alcala
	C. BMP. Algeciras – C. BMP. Ciudad de Malaga
Female	C. BMP. Algeciras – Deporte y Empresa Clinicas Rincon Malaga
	C. BMP. Ciudad de Malaga – C. BMP. Getasur juvenil Madrid
	C. BMP. Getasur junior Madrid – Deporte y Empresa Malaga
	C. BMP. Getasur junior Madrid – C. BMP. Getasur juvenil Madrid
	Jugui SOS Valencia (team no observed) – Deporte y Empresa Málaga
	Grupo Llopis BMP Sevilla (team no observed) – C. BMP. Algeciras

TABLE 2 | Observation instrument: criteria and corresponding categories and codes.

Criterion	Categories	Criterion	Categories
1. Minute	M1: minute one of first half M2: minute two of first half M3: minute three of first half M4: minute four of first half M5: minute five of first half M6: minute six of first half M7: minute seven of first half M8: minute eight of first half M9: minute nine of first half M10: minute 10 of first half M11: minute one of second half M12: minute two of second half M13: minute three of second half M14: minute four of second half M15: minute five of second half M16: minute six of second half M17: minute seven of second half M18: minute eight of second half M19: minute nine of second half M20: minute 10 of second half MGOL1: golden goal of first half MGOL2: golden goal of second half	2. Score	MPATE: tie 1FAV: observed team is ahead by one point 2FAV: observed team is ahead by two points M2FAV: observed team is ahead by more than two points 1CON: observed team is trailing by one point 2CON: observed team is trailing by two points M2CON: observed team is trailing by more than two points
3. Numerical balance	IGUAL: equality 1SUP: advantage of one M1SUP: advantage of more than one 1INF: disadvantage of one M1INF: disadvantage of more than one	4. Defensive system	S30: 3:0 defensive system S21: 2:1 defensive system S2M1: 2 + 1 defensive system SPRES: individual defensive system SREPL: retreat defensive system S20: 2:0 defensive system
5. Zone of end of attack	ZF1: attack ends in zone 1 ZF2: attack ends in zone 2 ZF3: attack ends in zone 3 ZF4: attack ends in zone 4 ZF5: attack ends in zone 5 ZF6: attack ends in zone 6 ZF7: attack ends in zone 7 ZF8: attack ends in zone 8 ZF9: attack ends in zone 9	6. Substitution area	BCS: attack ends in one of the zones adjacent to the observed team's substitution area BCNO: attack ends in one of the zones adjacent to the opposing team's substitution area. BCMED: attack ends in one of the central zones.
7. Assisting player	APETO: assist by specialist AXTRL: assist by left wing AXTRD: assist by right wing ACENT: assist by center APIV: assist by pivot NASIS: no assist	8. Player who ends attack	FPETO: specialist ends attack FXTRL: left wing ends attack FXTRD: right wing ends attack FCENT: center ends attack FPIV: pivot ends attack
9. How attack ends	FLY: attack ends with in-flight shot GIRO: attack ends with spin shot LANZ: attack ends with shot 6M: attack ends with 6-m throw ERRPR: attack ends with passing or catching error FTECN: attack ends with foul	10. Result of end of attack	GOL1: one-point goal GOL2: two-point goal ERLAN: missed shot CPOSE: change of possession G1SA: one-point goal and suspension G2SA: two-point goal and suspension 6MGOL: goal scored by 6-m throw 6MFA: missed 6-m throw GOL1R: one-point rebound goal GOL2R: two-point rebound goal 6MGSA: goal scored by 6-m throw and suspension 6MFSA: missed 6-m throw and suspension GOL1RSA: one-point rebound goal and suspension GOL2RSA: two-point rebound goal and suspension
11. Duration	D05: between 0 and 5 s D610: between 6 and 10 s D1115: between 11 and 15 s D1620: between 16 and 20 s D2125: between 21 and 25 s D2630: between 26 and 30 s DM30: more than 30 s		

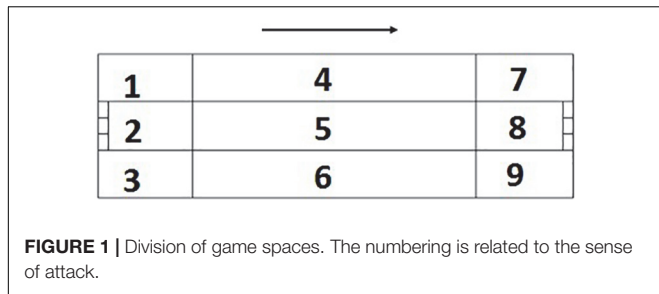


FIGURE 1 | Division of game spaces. The numbering is related to the sense of attack.

design allows to check the degree of differentiation of the proposed categories. The generalization coefficients for this design are invalid (0.000), this indicates that the homogeneity of the categories is optimal in the sense of differentiating.

Polar Coordinate Analysis

The polar coordinate analysis is an analysis technique widely used in recent years in the field of Sports Science is (Araújo et al., 2016; Maneiro et al., 2019; Vázquez-Diz et al., 2019a). There are numerous works that have been used to analyze different sports, football is the sport on that more research are published (Robles et al., 2014; Castañer et al., 2017; Maneiro and Amatria, 2018), although it can also be found in other sports such as taekwondo, basketball or karate (López-López et al., 2015; Nunes et al., 2015; Riveiro-Bozada et al., 2016). In handball, Sousa et al. (2014) characterized and detected effective behavioral vectors in offensive situations of two against two. And specifically, in the modality of beach handball, Morillo-Baro et al. (2015) analyzed the positional attack establishing differences by gender.

This technique has its origin in Sackett’s (1980) work and subsequent optimization with the “genuine technique” (Anguera, 1997), which allows to make a drastic reduction of data and a vectorial representation of the interrelationships established between the different categories that constitute the proposed taxonomic system (Hernández-Mendo and Anguera, 1999; Gorospe and Anguera, 2000). This technique is supported by a lag sequential analysis of prospective and retrospective delays (Sackett, 1980), with the genuine technique (Anguera, 1997) of the occurred successive conducts. The values obtained in the calculation of the conditioned probability will allow obtaining the parameter Z_{sum} ($Z_{sum} = \sum z / \sqrt{n}$, where n is the number of delays) (Cochran, 1954). The distribution of this parameter Z_{sum} has a $\bar{x} = 0$ and a SD = 1.

In obtaining these values the interrelation map of behaviors or a map of polar coordinates can be built (Gorospe and Anguera, 2000). For the construction of behavioral maps, it is necessary to determine the vector modules (to be considered significant they must be equal to or greater than 1.96). The radius or length of the radius is calculated by the square root of the sum of the square of the Z_{sum} of the X (prospective) and the square of the Z_{sum} of the Y (perspective).

$$\text{Radius} = \sqrt{x^2 + y^2}$$

The angle of the vector (φ) (which will depend on the quadrant where it is located) showing the nature of the relationship

TABLE 3 | Intra and inter-observer agreement.

Coefficient for entire session	Intra-observer agreement (Obs. 1 vs. Obs. 1bis)	Inter-observer agreement (Obs. 1 vs. Obs. 2)
Pearson’s	0.98	0.97
Spearman’s (ρ)	0.95	0.89
Kendall’s tau-b	0.95	0.91
Kappa	0.94	0.91
Phi	0.89	0.85

(Castellano and Hernández-Mendo, 2003). This angle (φ) is calculated as $\varphi = \text{Arc sine of } Y/\text{radius}$.

For coding and analysis of polar coordinates, the HOISAN computer program has been used (Hernández-Mendo et al., 2012). First, a sequential analysis is performed for each category of all the observations made with the selected criteria behavior, obtaining the Z results with a range of delays of -5 and 5. Once these values were obtained, the calculations were made to determine the Z_{sum} parameters (prospective and retrospective) (Sackett, 1980), the quadrant assignment, the radius, the angle, and the transformed angle (AT) for the rest of the categories (Castellano and Hernández-Mendo, 2003). The characterization of each quadrant is the following (Castellano and Hernández-Mendo, 2003):

Quadrant I [+ , +]: The given behavior is motivated with respect to the pairing performance behavior in retrospective and prospective perspective.

Quadrant II [- , +]: The given behavior has a relation with respect to the pairing of motivation in retrospective perspective and of inhibition in prospective perspective.

Quadrant III [- , -]: The given behavior has a relation with respect to the pairing of inhibition in retrospective and prospective perspective.

Quadrant IV [+ , -]: The given behavior has a relationship with the behavior of a motivated pairing performance in prospective perspective and inhibition in retrospective perspective.

The behavior selected as (focal) criteria have been: APETO and FPETO. These are the behaviors in which the role of the specialist is the main protagonist, in APETO (*peto* assists) the player who acts as a specialist makes the last pass to one of his/her teammates so that he/she finishes the positional attack by means of one of the ways of completion that are collected in the observation tool. While in FPETO (*peto* finalizes) is the specialist player who ends the action of the positional attack.

RESULTS

Therefore, the results obtained can be observed by analyzing polar coordinates for the selected behaviors as a criterion. **Table 4** shows the mating behaviors that are significantly linked when the criterion behavior is APETO. The results show, by quadrant and category, that when the criterion behavior is APETO, in quadrant I, where it is augmented in respect to the pairing

TABLE 4 | Relationships between focal behavior APETO and conditional behaviors.

Criterion behavior	Q	Male			Female		
		Pairing behavior	Vector module	T.A.	Pairing behavior	Vector module	T.A.
APETO	I	FPETO	2.22	64.5	ERLAN	2.59	66.98
		ZF5	1.98	52.45	GOL1	2.82	4.88
		BCMED	2.61	31.49	IGUAL	2.92	14.99
		1CON	3.33	37.52	S21	2.92	51.19
	II	M2FAV			M2FAV	3.01	32.28
					FLY	3.45	45.86
					FXTRD	3.5	53.59
					ZF9	3.56	23.59
					2CON	5.19	70.36
	III	M2CON	4.31	168.58	D2125	2.8	128.52
		SPRES	2.21	124.66			
		LANZ	2.81	99.65			
		FXTRI	2.04	202.56	1INF	2	207.19
		6MGSA	2.09	236.98	ERRPR	2.23	224.14
		ZF4	2.37	191.17	1SUP	2.29	181.01
		D1620	2.57	232.89	S20	2.62	192.03
		S2M1	2.75	198.33	CPOSE	2.69	235.12
		M2FAV	2.77	208.08	2FAV	2.7	199.88
		GIRO	3.03	209.48	EMPATE	4.23	261.4
					D05	2.89	182
IV	FPIV	2.02	339.59	ZF4	3.2	234.86	
	FLY	2.45	345.2	1FAV	3.23	224.86	
	2CON	2.95	348.74	SPRES	3.58	244.38	
	2FAV	3.21	271.17	1CON	3.77	229.08	
	6MGOL	3.33	352.09	D610	2.78	320.55	

Legend: Q, Quadrant; T.A., transformed angle; FPETO, specialist ends attack; ZF5, attack ends in zone 5; BCMED, attack ends in one of the central zones; 1CON, observed team is trailing by one point; ERLAN, missed shot; GOL1, one-point goal; IGUAL, equality; S21, 2:1 defensive system; FLY, attack ends with in-flight shot; FXTRD, right wing ends attack; ZF9, attack ends in zone 9; 2CON, observed team is trailing by two points; M2CON, observed team is trailing by more than two points; SPRES, individual defensive system; LANZ, attack ends with shot; D2125, between 21 and 25 s; FXTRI, left wing ends attack; 6MGSA, goal scored by 6-m throw and suspension; ZF4, attack ends in zone 4; D1620, between 16 and 20 s; S2M1, 2 + 1 defensive system; M2FAV, observed team is ahead by more than two points; GIRO, attack ends with spin shot; 1INF, disadvantage of one; ERRPR, attack ends with passing or catching error; 1SUP, advantage of one; S20, 2:0 defensive system; CPOSE, change possession; 2FAV, observed team is ahead by two points; EMPATE, tie; D05, between 0 and 5 s; 1FAV, observed team is ahead by one point; FPIV, pivot ends attack; 6MGOL, goal scored by 6-m throw; D610, between 6 and 10 s.

behavior in retrospective and prospective perspective, in the male category it is associated with four pairing behaviors, highlighting the zone of completion five (ZF5), the band of medium change (BCMED), and the result of a goal against (1CON); whereas in the female category it is associated with nine pairing behaviors, highlighting the throwing error (ERLAN), the flight (FLY), the player that finishes is the far right (FXTRD) for the finishing area nine (ZF9) and a defensive system two in line and one in advance (S21).

In quadrant II, where the criterion behavior has a relationship with respect to that of augmented performance in pairing in retrospective perspective and of inhibition in prospective perspective, in male category, it is only associated with three pairing behaviors, being the result more than two in against (M2CON) the one that greater intensity in the relationship

presents. Meanwhile, in the female category, only a pairing behavior appears, which is the duration of the attack between 21 and 25 s (D2125).

In quadrant III, the criterion behavior has a relationship with respect to the pairing of inhibition in retrospective and prospective perspective. In the male category, there are seven pairing behaviors, of those it can stand out the way of ending in spin shot (GIRO), the defensive system of the opposing team two plus one (S2M1), the player that ends is the left wing (FXTRI), the zone of end four (ZF4) and the result of more than two goals in favor (M2FAV). In the female category, it is related to twelve pairing behaviors, of which can distinguish the defensive system of the opposing team (SPRES), the pass or reception error (ERRPR), the change of possession (CPOS) and the duration of the attack less than 5 s (D05).

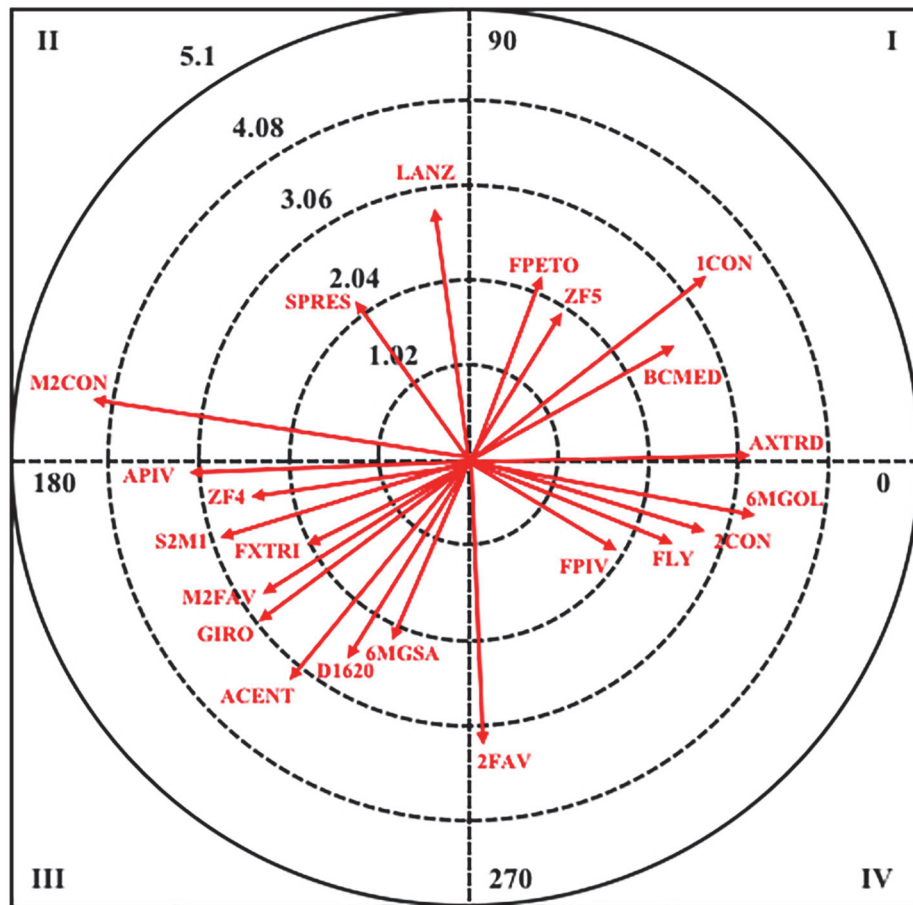


FIGURE 2 | Vector map for focal behavior APETO in male category.

Finally, in quadrant IV, the criterion behavior has a relationship with the behavior of augmented pairing in prospective perspective and inhibition in retrospective perspective. In masculine category, it is related to five pairing behaviors, being the result of two goals in favor (2FAV) the behavior that greater radio has shown, while, in feminine category, it is associated only with a pairing behavior, the duration of the attack between 6 and 10 s (D610).

Next, in **Figure 2**, it can be observed the resulting graphical representation from the analysis of polar coordinates for this criterion behavior in male category.

In **Figure 3**, is represented the graphical representation for the female category.

Table 5 shows the results obtained when the criterion behavior is FPETO.

In quadrant I, in male category, it is related to seven pairing behaviors, being the most important the finishing zone five (ZF5) and six (ZF6), the finishing mode in launch (LANZ), the defensive system of the opposing team 3:0 (S30), and the result of a goal in favor (1FAV) and a goal against (1CON). In female category, on the other hand, it can stand out the finishing zone four (ZF4) and the

defensive system two in line plus one player in advanced individual defense.

In quadrant II, in the male category, a pairing behavior appears only as the result of two goals against (2CON), as in the female category, the duration of the attack between 6 and 10 s (D610).

In quadrant III, in the male category, it is related to eleven pairing behaviors, highlighting the missed shot (ERLAN) and the defensive system of the opposing team, two players in line and one advanced (S21), this being the one with the largest module of vector. In the female category, only two pairing behaviors appear, the result of more than two goals ahead (M2FAV), which is the one with the highest radius, and the zone of completion seven (ZF7).

In quadrant IV, in the male category only one pairing behavior is found, the zone of completion nine (ZF9); while in the female category four can be found, emphasizing the duration of the attack of 5 s (D05) over the rest.

Next, in **Figure 4**, the graphical representation resulting from the analysis of polar coordinates for this focal behavior can be observed.

In **Figure 5** the graphical representation for the female category is represented.

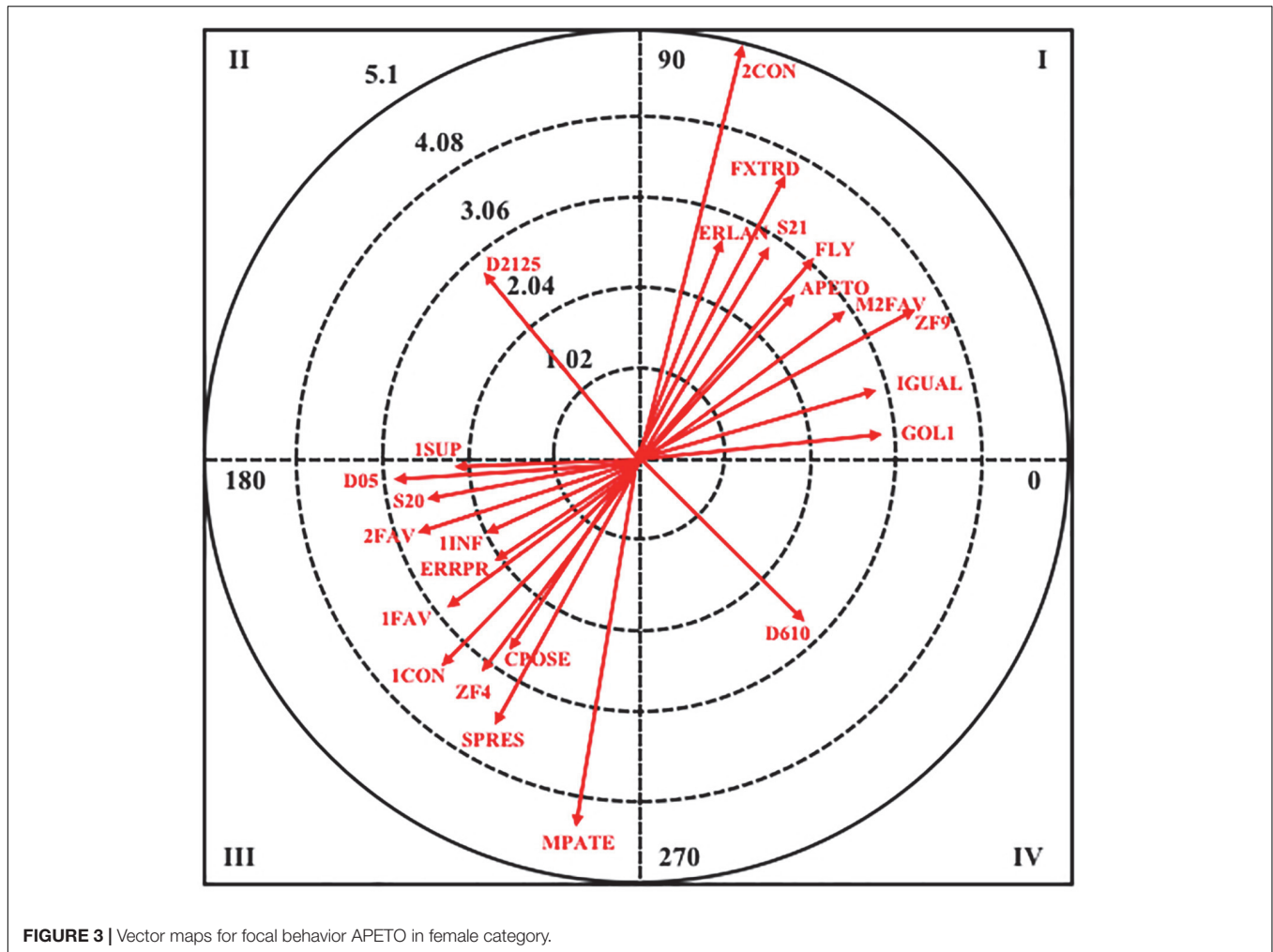


FIGURE 3 | Vector maps for focal behavior APETO in female category.

DISCUSSION

The aim of this study was to analyze the decision making of beach handball players who acquire the role of specialist according to the behavior they have shown, from the framework of mixed methods. To do this, the aim has been to identify the relationships that were established between behaviors used as a criterion, those that showed their decision-making by performing assists and completions, with pairing behaviors of the selected criteria of the tool: score, defensive system of the opposing team, zone of end of the attack, player that ends, end mode and duration of the attack. The results showed differences between the flow of behaviors that are significantly linked in the male category compared to the female category, which coincides with the results obtained in the studies published on this modality so far (Morillo-Baro et al., 2015; Vázquez-Diz et al., 2019a).

Firstly, and in the male category, the specialist's assists are associated with the score against, which is manifested in the four quadrants of the table of results. These indicate that the situation of numerical superiority and his ability to fix opponents do not positively relate the score with the performance of assists, therefore, it seems that the participation of this position goes

more toward decisions of continuity in actions and completion of the attack than toward decision making of the last pass. In this sense, the research by Vázquez-Diz et al. (2019a) relates the success in the decision making in a positive way with a favorable score. Another remarkable result is that the area of the court where male teams tend to end their attacks when the assist is made by the specialist is in the central zone, results that do not coincide with those obtained by Morillo-Baro et al. (2015). Data that shows a tactical evolution in the game in male category, either to solve the absence of left-handed players or to look for solutions before the increasingly better defensive systems. In addition, the assist of the specialist player cannot be associated with the completion in turn, a result that falls within the logic, since this gesture does not need tactical collaboration unlike the shot in flight (Morillo-Baro et al., 2017a). When inhibiting the behaviors referring to the defensive pressing systems, it is reasonable to think that this player performs his actions before closed defensive systems, a result that agrees with the research of Morillo-Baro et al. (2015). Individual defensive systems have a negative performance improvement in the women's category, specifically with errors of pass and reception, as shown, the results of the study by Vázquez-Diz et al. (2019a).

TABLE 5 | Relationships between focal behavior FPETO and conditional behaviors.

Criterion behavior	Q	Male			Female		
		Pairing behavior	Vector module	T.A.	Pairing behavior	Vector module	T.A.
FPETO	I	ZF5	2.17	34.71	ZF4	2.28	32.94
		LANZ	2.74	34.58	S2M1	2.54	71.6
		BCSI	3.34	52.87	MPATE	2.84	35.19
		ZF6	3.48	78.49	2FAV	3.99	53.07
		1FAV	3.97	8.29			
		1CON	5	48.87			
		S30	5.39	28.5			
	II	2CON	2.3	148.77	D610	2.04	149.28
		D610	1.98	216.47	ZF7	2.46	197.64
		MPATE	2.06	191.46	M2FAV	3.8	208.53
		2FAV	2.27	265.28			
		ZF8	2.29	227.09			
	III	6MGSA	2.32	191.5			
		ERLAN	2.39	188.04			
		M2FAV	2.92	219.93			
		FLY	3.42	240.37			
		BCNO	3.49	214.29			
		AXTRD	3.7	212.82			
		S21	6.72	215.09			
	IV	ZF9	2.42	308.21	2CON	2.13	273.57
					6M	2.16	334.60
					DM30	2.41	343.01
					D05	2.51	341.55

Legend: Q, Quadrant; T.A., transformed angle; ZF5, attack ends in zone 5; LANZ, attack ends with shot; BCSI, attack ends in one of the zones adjacent to the observed team's substitution area; ZF6, attack ends in zone 6; 1FAV, observed team is ahead by one point; 1CON, observed team is trailing by one point; S30, 3:0 defensive system; ZF4, attack ends in zone 4; S2M1, 2 + 1 defensive system; MPATE, tie; 2FAV, observed team is ahead by two points; 2CON, observed team is trailing by two points, D610, between 6 and 10 s; ZF8, attack ends in zone 8; ZF7, attack ends in zone 7; M2FAV, observed team is more than two points; 6MGSA, goal scored by 6-m throw and suspension; ERLAN, missed shot; FLY, attack ends with in-flight shot; BCNO, attack ends in one of the zones adjacent to the opposing team's substitution area; AXTRD, assist by right wing; S21, 2:1 defensive system; ZF7, attack ends in zone 7; ZF9, attack ends in zone 9; 2CON, observed team is trailing by two points; 6M, attack ends with 6-m throw; DM30, more than 30 s; D05, between 0 and 5 s.

On the other hand, in relation to the specialist's completion in the male category, both the score for and against the central and right end zone and by a launch faced with a closed defensive system can be associated, as behaviors are inhibited related to open and pressing defenses; data that agree in part with those of the Morillo-Baro et al. (2015), since in that research the closed defensive system and the favorable score are also augmented. A result that could be due to the entrance of the specialist player in his most effective shooting area and, being the majority of the players that act in this position of right-handed players, to the natural tendency to play toward the players strong point, where he has more guarantees to shoot. Finally, when he decides to finalize he does it successfully, because shoot errors are inhibited and they are not linked to other possible negative completion options for the team, such as technical fouls or pass-reception errors, aspects that show his correct choice in the game of numerical superiority.

For the female category, the specialist's assist activates the completion by the extreme right in flight, in her usual area of action and before an open defensive system. This is a result that could be due to the fact that the majority of players who

occupy the position of specialist are right-handed, and therefore they tend to play toward their strong point, from left to right. The open defensive systems chosen by the women's teams are based on the need to limit the specialist's actions, since their participation in decision making and completion is more decisive than in the male category (Morillo-Baro et al., 2015). It is worth mentioning that, although the error in shooting is also activated, it should not be interpreted as an erroneous decision of the specialist since, although the right end fails the shot, the attack always ends with the option to score. Reasoning that is reinforced with the inhibition of pass-reception error behavior and change of possession in quadrant III; the inhibition of these behaviors, related to the failure of the positional attack, could be associated with a correct decision making by the specialist. The results of this quadrant, like those of the fourth, also indicate that the specialist's assist is usually given once the first 10 s have passed.

Regarding the specialist's finalization, the fact that it occurs toward the left end zone stands out, toward her weak point if it is a right-handed player and faced with an open defensive system. And comparing the duration of the attack when she decides to finish instead of assisting, the players elaborate the attack less, developing it in less time. Contrary to the results shown by

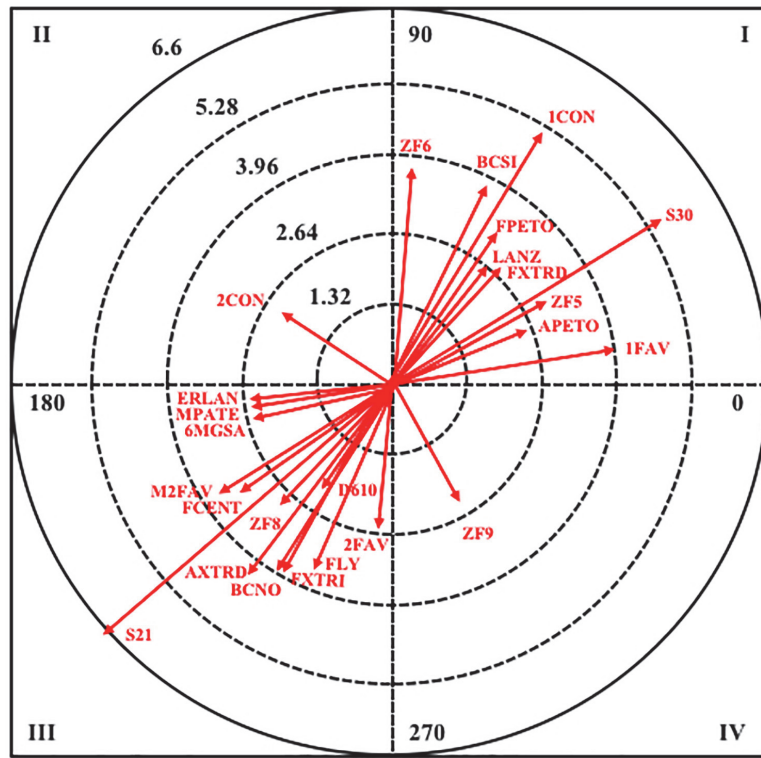


FIGURE 4 | Vector maps for focal behavior FPETO in male category.

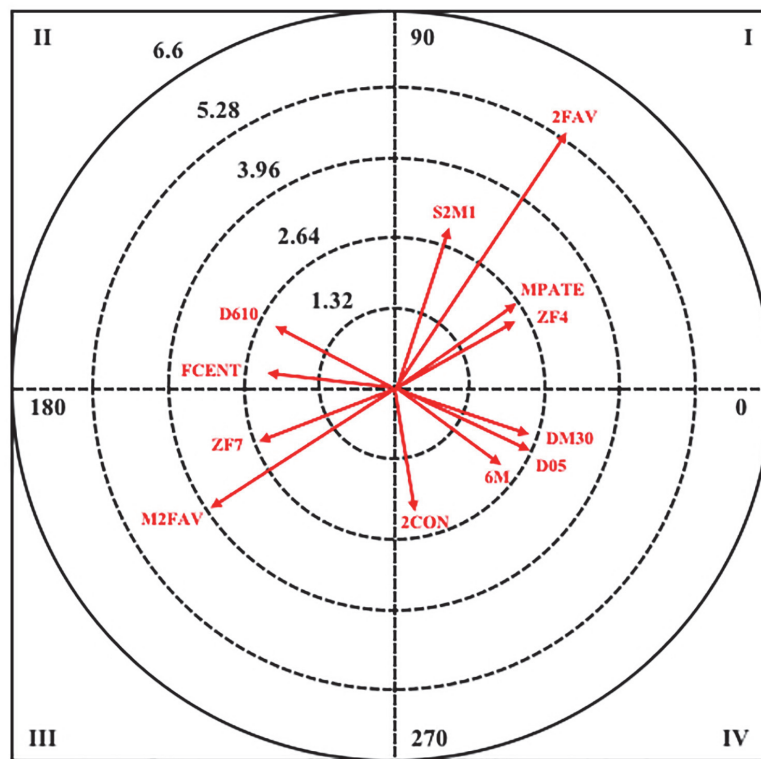


FIGURE 5 | Vector maps for focal behavior FPETO in female category.

Vázquez-Diz et al. (2019a) where a longer length of attack is related to behaviors of success.

Based on all these results, one might think that in the male category the decision of the specialist's decision-making when he assists is linked to an unfavorable score, while in the female category that decision making is independent of the score. On the other hand, when the specialist decides to finish it is interpreted as a correct decision making since it inhibits behaviors related to the failure, while, in the feminine category, there are no behaviors to link to the result of the completion, therefore, it can mean success or not in the decision making. It is also noteworthy that in the male category both the completion and assistance of the specialist is given defensive closed system, a logical issue that allows greater freedom of action on the part of this player, while in the female category despite having open defensive systems they do not decrease the actions of this player, data that reveals the importance of this role, more if possible, in this category. Finally, the specialist's assist is not related to the turn in the male category and in the female category it is related to the flight, this means that both categories use the flight as a main resource against the turn, data that do not agree with those obtained by Morillo-Baro et al. (2015) and Ostoić and Ohnjec (2015), where the turn proved to be the main resource to obtain double scoring goals in both categories.

There is hardly any published research on this modality, which suggests some caution to draw conclusions about the estimated data. One of the cautions is the limitation that means to interpret decision making by observing behaviors, being unaware of other cognitive variables that surely influence. Finally, it is also important to note that the sample was composed only by Spanish players; therefore, this study is focused solely on the development of the game of Spanish teams. All these results have shown the importance of the specific position of the specialist in the development of the attacks within the offensive systems of

the teams, and the greater or lesser accuracy that they have when the decision making of this player is correct or not. The use of systematic observation to analyse specific actions and behaviors, in the framework of mixed methods, can provide complementary ideas on the complex process of decision making in sport (Araújo et al., 2016). This has been possible thanks to the use of polar coordinate analysis, a tool that has become very useful to detect the significant relationships of the criterion behaviors chosen with the different pairing behaviors that correspond to the different facets of the game. For all this, it would be of great interest to continue exploring this line of research on beach handball, creating new investigations with different focal behaviors to be able to establish the different patterns of the game in both categories.

AUTHOR CONTRIBUTIONS

AH-M, VM-S, and RR designed the study and acquired, analyzed, and interpreted the data. JM-B acquired, analyzed, and interpreted the data. JV-D acquired and analyzed the data. All authors drafted, revised, and approved the final version of the manuscript, and agreed to be accountable for all aspects of the work.

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REFERENCES

- Anguera, M. T. (2003). "La observación [Theobservation]," in *Evaluación psicológica. Concepto, proceso y aplicación en las áreas de desarrollo y de la inteligencia*, ed. C. Moreno Rosset (Madrid: Sanz y Torres), 271–308.
- Anguera, M. T., Blanco-Villaseñor, A., Hernández-Mendo, A., and Losada, J. L. (2011). Diseños observacionales: ajuste y aplicación en psicología del deporte [Observational designs: theirsuitability and application in sportspsychology]. *Cuad. Psico. Dep.* 11, 63–76.
- Anguera, M. T., Camerino, O., Castañer, M., Sánchez-Algarra, P., and Onwuegbuzie, A. J. (2017). The specificity of observational studies in physical activity and sports sciences: moving forward in mixed methods research and proposals for achieving quantitative and qualitative symmetry. *Front. Psychol.* 8:2196. doi: 10.3389/fpsyg.2017.02196
- Anguera, M. T. (ed.) (1997). "From prospective patterns in behavior to joint analysis with a retrospective perspective," in *Colloque Sur Invitation «Méthodologie d'analyse des interactions sociales»*, (Paris: Université de la Sorbona).
- Anguera, M. T., and Hernández-Mendo, A. (2013). La metodología observacional en el ámbito del deporte [Observational methodology in sport sciences]. *E-balonmano.com: Rev. Cien. Dep.* 9, 135–160.
- Anguera, M. T., and Hernández-Mendo, A. (2014). Metodología observacional y psicología del deporte: estado de la cuestión [Observational methodology and sportspsychology: state of affairs]. *Rev. Psicol. Dep.* 23, 103–119.
- Anguera, M. T., and Hernández-Mendo, A. (2015). Técnicas de análisis en estudios observacionales en ciencias del deporte [Data analysis techniques in observational studies in sport sciences]. *Cuad. Psico. Dep.* 15, 13–30. doi: 10.4321/S1578-84232015000100002
- Anguera, M. T., Magnusson, M. S., and Jonsson, G. K. (2007). Instrumentos no estandar [Non-standard instruments]. *Avances en Medicina* 5, 63–82.
- Araújo, D., Teques, P., Hernández-Mendo, A., Reigal, R. E., and Anguera, M. T. (2016). La toma de decisión, ¿es una conducta observable?: discusión sobre diferentes perspectivas teóricas utilizadas en el estudio del rendimiento deportivo [Decision-making, is itan observable behaviour?: discussion of contrasting theoretical perspectives in use in the study of sport performance]. *Cuad. Psico. Dep.* 16, 183–196.
- Belančić, Z. (2005). *Rukomet na Pijesku. [Beach handball. In Croatian.]*. Zagreb: Zagrebački Rukometni Savez.
- Blanco-Villaseñor, A., Castellano, J., Hernández-Mendo, A., Sánchez-López, C. R., and Usabiaga, O. (2014). Aplicación de la TG en el deporte para el estudio de la fiabilidad, validez y estimación de la muestra [Application of the generalizability theory in sport to study the validity, reliability and estimation of samples]. *Rev. Psicol. Dep.* 23, 131–137.
- Carling, C. (2011). Influence of opposition team formation on physical and skill-related performance in a professional soccer team. *Eur. J. Sport Sci.* 11, 155–164. doi: 10.1080/17461391.2010.499972
- Castañer, M., Barreira, D., Camerino, O., Anguera, M. T., Fernandes, T., and Hileno, R. (2017). Mastery in goal scoring, T-pattern detection, and polar coordinate analysis of motor skills used by Lionel Messi

- and Cristiano Ronaldo. *Front. Psychol.* 8:741. doi: 10.3389/fpsyg.2017.00741
- Castellano, J., and Hernández-Mendo, A. (2003). El análisis de coordenadas polares para la estimación de relaciones en la interacción motriz en fútbol [Polar coordinates analysis to estimate relationships in the motor interaction in soccer]. *Psicothema* 15, 569–579.
- Cochran, W. G. (1954). Some methods for strengthening the common χ^2 test. *Biometrics* 10, 417–451. doi: 10.2307/3001616
- Conejero, M., Claver, F., Fernández-Echeverría, C., and Moreno, M. P. (2018). Relationship between decision-making and performance in game actions in volleyball. *Eur. J. Hum. Move.* 39, 82–95.
- Gelfand, D. M., and Hartmann, D. P. (1975). *Child Behavior Analysis and Therapy*. Michigan: Pergamon Press.
- Gonzales, J., Mishra, S., and Camp, R. D. (2017). For the win: Risk-sensitive decision-making in teams. *J. Behav. Decis. Mak.* 30, 462–472. doi: 10.1002/bdm.1965
- González, A. (2012). *Análisis de la Eficacia del Contraataque en Balonmano como Elemento de Rendimiento Deportivo* [Analysis of Fast Break's Efficiency in Handball as an Element of Sport Performance]. Ph.D. thesis, Universidad de León, León.
- González, A., Botejara, J., Puñales, L., Trejo, A., and Ruy, E. (2013). Análisis de la finalización del ataque en partidos igualados en balonmano de alto nivel mediante coordenadas polares [Analysis of the finalization of the attack in equalized games of high level handball using polar coordinates]. *E-balonmano.com: Rev. Cien. Dep.* 9, 71–89.
- Gorospé, G., and Anguera, M. T. (2000). Modificación de la técnica clásica de coordenadas polares mediante un desarrollo distinto de la retrospectividad: aplicación al tenis [Retrospectivity in polar coordinates analysis: application to tennis]. *Psicothema* 12, 279–282.
- Gruic, I., Vuleta, D., Bazzo, M., and Ohnjec, K. (2011). "Situational efficiency of teams in female part of tournament in the World Beach Handball Championship in Cadiz," in *Proceedings of the 6th International Scientific Conference on Kinesiology*, Croatia, 524–528.
- Helm, F., Reiser, M., and Munzert, J. (2016). Domain-specific and unspecific reaction times in experienced team handball goalkeepers and novices. *Front. Psychol.* 7:882. doi: 10.3389/fpsyg.2016.00882
- Hernández-Mendo, A., and Anguera, M. T. (1999). "Aportaciones de análisis de coordenadas polares a los deportes de equipo [Contributions of polar coordinate analysis to team sports]," in *La Psicología del Deporte en España al Final del Milenio*, ed. F. Guillén (Las Palmas: Universidad de Las Palmas de Gran Canaria), 169–175.
- Hernández-Mendo, A., Blanco-Villaseñor, A., Pastrana, J. L., Morales-Sánchez, V., and Ramos-Pérez, F. J. (2016). SAGT: aplicación informática para análisis de generalizabilidad [SAGT: new software for generalizability analysis]. *Rev. Iberoam. Psicol. Ejerc. Dep.* 11, 77–89.
- Hernández-Mendo, A., López-López, J. A., Castellano, J., Morales-Sánchez, V., and Pastrana, J. L. (2012). Hoisan 1.2: programa informático para uso en metodología observacional [Hoisan 1.2: computer program for use in observational methodology]. *Cuad. Psico. Dep.* 12, 55–78. doi: 10.4321/S1578-84232012000100006
- Hodges, N. J., Huys, R., and Starkes, J. L. (2007). "Methodological review and evaluation of research in expert performance in sport," in *Handbook of Sport Psychology*, eds G. Tenenbaum and R. C. Eklund (New Jersey, NJ: John Wiley & Sons), 161–183.
- Jiménez-Salas, J., and Hernández-Mendo, A. (2016). Análisis de la calidad del dato y generalizabilidad de un sistema de observación del contraataque en el balonmano de élite [Analysis of data quality and generalizability observing system counter in elite handball]. *E-Balonmano.com: Rev. Cien. Dep.* 12, 31–44.
- Landis, J. R., and Koch, G. G. (1977). The measurement of observer agreement for categorical data. *Biometrics* 33, 159–174. doi: 10.2307/2529310
- Levi, H. R., and Jackson, R. C. (2018). Contextual factors influencing decision making: perceptions of professional soccer players. *Psychol. Sport. Exe.* 37, 19–25. doi: 10.1016/j.psychsport.2018.04.001
- Loffing, F., Sölter, F., Hagemann, N., and Strauss, B. (2015). Accuracy of outcome anticipation, but not gaze behavior, differs against left- and right-handed penalties in team-handball goalkeeping. *Front. Psychol.* 6:1820. doi: 10.3389/fpsyg.2015.01820
- López-López, J. A., Menescardi, C., Estevan, I., Falcó, C., and Hernández-Mendo, A. (2015). Análisis técnico-táctico en Taekwondo con coordenadas polares a través del software HOISAN [Technical-tactical analysis in Taekwondo with polar coordinates through software HOISAN]. *Cuad. Psico. Dep.* 15, 131–142. doi: 10.4321/s1578-84232015000100013
- Maneiro, R., and Amatria, M. (2018). Polar coordinate analysis of relationships with teammates, areas of the pitch, and dynamic play in soccer: a study of Xabi Alonso. *Front. Psychol.* 9:389. doi: 10.3389/fpsyg.2018.00389
- Maneiro, R., Amatria, M., and Anguera, M. T. (2019). Dynamics of Xabi Hernández's game: a vectorial study through polar coordinate analysis. *Proc. Inst. Mech. Eng. Part P J. Sports Eng. Technol.* doi: 10.1177/1754337119830472 [Epub ahead of Print].
- Morillo-Baro, J. P., and Hernández-Mendo, A. (2015). Análisis de la calidad del dato de un instrumento para la observación del ataque en balonmano playa [Analysis of quality data a tool for observing the attack in beach handball]. *Rev. Iberoam. Psicol. Ejerc. Dep.* 10, 15–22.
- Morillo-Baro, J. P., Lara, D., Sánchez-Sáez, J. A., Sánchez-Malia, J. M., and Zapardiel, J. C. (2017a). *Balonmano Playa. La Formación del Entrenador* [Beach Handball. Coach Training]. Madrid: Royal Spanish Handball Federation.
- Morillo-Baro, J. P., Reigal, R. E., Hernández-Mendo, A., Montaña, A., and Morales-Sánchez, V. (2017b). Decision-making by handball referees: design of an ad hoc observation instrument and polar coordinate analysis. *Front. Psychol.* 8:1842. doi: 10.3389/fpsyg.2017.01842
- Morillo-Baro, J. P., Reigal, R. E., and Hernández-Mendo, A. (2015). Análisis del ataque posicional de balonmano playa masculino y femenino mediante coordenadas polares [Analysis of positional attack in beach handball male and female with polar coordinates]. *Rev. Int. Cien. Dep.* 11, 226–244. doi: 10.5232/ricyde2015.04103
- Nunes, H., Iglesias, X., Daza, G., Irrutia, A., Caparrós, T., and Anguera, M. T. (2015). Influencia del pick and roll en el juego de ataque en baloncesto de alto nivel [The influence of pick and roll in attacking play in top-level basketball]. *Cuad. Psico. Dep.* vol. 16, 129–142.
- Ostoic, S., and Ohnjec, K. (2015). *2015 Beach Handball European Championships Qualitative Analysis*. Vienna: EHF Web Periodical.
- Plano-Clark, V. L., and Sanders, K. (2015). "The use of visual displays in mixed methods research," in *In Use of Visual Displays in Research and Testing*, eds M. T. McCrudden, G. Schraw, and C. W. Buckendahl (Charlotte, NC: Information Age Publishing, Inc.), 177–206.
- Portell, M., Anguera, M. T., Hernández-Mendo, A., and Jonsson, G. K. (2015). Quantifying biopsychosocial aspects in everyday contexts: an integrative methodological approach from the behavioral sciences. *Psychol. Res. Behav. Manage.* 8, 153–160. doi: 10.2147/PRBM.S82417
- Prudente, J., Sousa, D., Sequeira, P., López-López, J. A., and Hernández-Mendo, A. (2017). Analyzing the influence of playing time and partial score on the tactical behavior in the duel 2 vs 2 in the offensive process in handball, using the polar coordinates technique. *An. Psico.* 33, 515–529. doi: 10.6018/analesps.33.3.271071
- Riveiro-Bozada, A., García-García, O., Serrano-Gómez, V., Morales-Sánchez, V., López-López, J. A., and Hernández-Mendo, A. (2016). Influencia del nivel de competición en las acciones técnicas de punto realizadas en Shiai Kumite femenino de karate. *Análisis de coordenadas polares* [Influence the level of competition in technical actions performed point female Shiai Kumite -karate]. *Cuad. Psico. Dep.* 16, 51–68.
- Robles, J. F., Castellano, J., and Perea, A. (2014). Diferencias del juego entre la selección española de fútbol y sus rivales [Differences of the game between the football Spanish team and its rivals]. *Rev. Ibero. Cien. Act. Fis. Dep.* 3, 1–8.
- Sackett, G. P. (1980). "Lag Sequential Analysis as a data Reduction Technique in Social Interaction Research," in *Exceptional Infant. Psychosocial Risks in Infant-Environment Transactions*, eds D. B. Sawin, R. C. Hawkins, L. O. Walker, and J. H. Penticuff (New York, NY: Brunner/Mazel), 300–340.
- Sarmiento, H., Clemente, P. M., Araújo, D., Davids, K., McRobert, A., and Figueiredo, A. (2017). What performance analysts need to know about research

- trends in Association Football (2012-2016). *Sports Med.* 48, 799–836. doi: 10.1007/s40279-017-0836-6
- Sousa, D., Prudente, J., Sequeira, P., and Hernández-Mendo, A. (2014). Análise da qualidade dos dados de um instrumento para observação do 2vs2 no andebol [Analysis of 2vs2 situations in men's european handball championship 2012: application of polar coordinates technique]. *Rev. Iberoam. Psicol. Ejerc. Dep.* 9, 173–190.
- Tashakkori, A., and Teddlie, C. (1998). *Mixed methodology: Combining Qualitative and Quantitative Approaches. Applied Social Research Methods Series*, Vol. 46. Thousand Oaks, CA: Sage.
- Tezcan, B. (2013). *2013 Beach Handball European Championships Qualitative Analysis*. Vienna: EHF Web Periodical.
- Vázquez-Diz, J. A., Morillo-Baro, J. P., Reigal, R. E., Morales-Sánchez, V., and Hernández-Mendo, A. (2019a). Contextual factors and decision-making in the behavior of finalization in the positional attack in beach handball: differences by gender through polar coordinates analysis. *Front. Psychol.* 10:1386. doi: 10.3389/fpsyg.2019.01386
- Vázquez-Diz, J. A., Morillo-Baro, J. P., Reigal, R. E., Morales-Sánchez, V., and Hernández-Mendo, A. (2019b). Diseño y validación de una herramienta de observación para porteros en balonmano playa [Design and validation of an observational instrument for goalkeepers in beach handball]. *Cuad. Psico. Dep.* 19, 127–138.
- Zapardiel Cortés, J. C. (2015). *Valoración Isocinética de los Músculos Rotadores del Complejo Articular del hombro en jugadores de balonmano playa* [Isokinetic Evaluation of the Rotator Muscles of the Articular Complex of the shoulder in beach handball players]. Ph.D.thesis, Universidad de Alcalá de Henares, Madrid.
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