

# Analysis of the differences in serve effectiveness between Billie Jean King Cup (former Fed Cup) and Davis Cup doubles tennis matches

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## Abstract

The doubles game has considerable relevance in professional tennis, especially in team competitions such as the Billie Jean King Cup (former Fed Cup) (BJKC) and the Davis Cup (DC). However, there are very few studies that have carried out quantitative notational analysis to provide information on the specific features of this tennis modality. The goal of this study was to analyse the differences in serve direction and effectiveness of male and female teams in matches played at BJKC and DC ties. A total of 29,207 serves; 7,578 of BJKC and 21,628 of DC matches were analysed. The data was obtained through the Hawk-Eye system. The results showed that with the first serve, both BJKC and DC teams tried to move the receiver by serving to zones W (wide) and T to take the initiative of the point, while with the second serve teams took lower risks and mainly served to zone B (body). In general, in DC matches the effectiveness of the serve was greater than in BJKC ones. The first serve effectiveness in DC matches was found to be higher in each direction, while the differences in the effectiveness of the second serve was only found in the zone C (body) of the advantage service box. This information can be particularly relevant for coaches to design the doubles training sessions and the strategic planning of doubles matches on reliable and quantitative information.

## Keywords

Gender, performance analysis, racket sport

## Introduction

The doubles game has considerable relevance in professional tennis: All events of the tournament calendar of the Association of Tennis Professionals (ATP) and the International Tennis Federation (ITF), whether they are individual or team competitions, include a doubles draw.<sup>1,2</sup> Furthermore, the new formats of team competitions, such as the Davis Cup or the ATP Cup, provide greater prominence to this discipline by playing only 3 matches per tie, in which the deciding point is the doubles match.

Despite the relevance of doubles in the professional tennis game, this discipline has not enjoyed much popularity in research. A few authors have shown some interest in aspects such as the gender differences,<sup>3</sup> the implicit coordination,<sup>4</sup> the communication between the team members,<sup>5,6</sup> the players' rating,<sup>7</sup> the scoring systems,<sup>8</sup> the interaction between the players<sup>9</sup> or the teams

and players.<sup>10</sup> In addition, some coaching literature has focused on the tactics of tennis doubles at different levels of the game, from recreational to professional male and female players,<sup>11–16</sup> but this was usually not based on data obtained through notational analysis that provided quantitative data on the specific features of the game.

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One of the most important aspects for the design and implementation of tennis training programmes is their specificity. This training principle has been defined as the ability to reproduce as precisely as possible during the training session the characteristics of the competition.<sup>17,18</sup> With this goal in mind, in our literature review only three studies were found that provided statistical data on the technical and tactical aspects of the doubles game. Carboch & Kočib,<sup>19</sup> analysed the effectiveness of the serve in both male and female teams on different surfaces. They found that male teams won 10% more serves than female teams and they needed more points to the serve to win the match. In addition, they showed that, on hard courts the serve was a greater advantage for both male and female teams, while the effectiveness of the serve on clay court was lower for both genders. On the other hand, Martínez-Gallego et al.<sup>20</sup> described the basic characteristics of the structure of the game and established how the points finalised in doubles. The results of this study showed important differences in the structure of the game between singles and doubles. The authors concluded that the most frequent patterns for finishing points in doubles were the winning shots and the serves. Finally, Kocib et al.<sup>21</sup> analysed the frequency and efficiency of the tactical formations used by doubles teams in the serve and in the return of serve. They found that the classic and “I” formations, which were the most used in the serve, obtained a similar effectiveness. As for the return of serve, in the return of the first serves, the teams mainly chose to play with both players at the back of the court, while in the return of the second serves they chose, in most cases, to play with the classic return of serve team formation of one up and one back.

As it can be concluded from these previous studies, the serve in doubles has devoted considerable interest from researchers. Studies have shown that it is a decisive shot in doubles since it allows teams to win a higher percentage of points when they are serving than when they are returning the serve,<sup>19</sup> and it is the shot with which the most points are won in tennis doubles.<sup>20</sup> Furthermore, in the singles game, the serve has been most studied shot and many studies have demonstrated its importance in the game<sup>22–24</sup> and the ranking.<sup>25</sup> Due to its importance, a number of variables related to the serve have been studied, such as the differences in performance as a function of the surface,<sup>26</sup> the importance of the point in play<sup>27,28</sup> or the gender of the players.<sup>17</sup>

For instance, the use of data obtained through automatic tracking systems, such as Hawk-Eye, has provided a considerable amount of very specific information about the differences in performance of professional players in the singles game,<sup>17</sup> as well as on the influence

of the serve in the point outcome.<sup>29</sup> However, to the authors’ knowledge, there is no study to date that has used data obtained through this type of system to analyse specific features of the doubles game. Furthermore, as aforementioned, although some previous studies have analysed a number of aspects related to the serve in doubles, none of them have analysed the differences in the serve performance between male and female doubles professional teams. Therefore, the objective of this study was to analyse the differences in terms of the directions and the effectiveness of the serve in male and female doubles teams, during the most important and traditional team competitions in the game, the Davis Cup (DC) and the Billie Jean King Cup (BJKC) former Federation Cup.

## Method

### Sample

The study sample consisted of a total of 29,207 serves. 7,578 were from BJKC matches ( $n=46$ ) and 21,628 corresponded to DC matches ( $n=96$ ). All the matches were part of qualifying draws ties played on hard courts between 2010 and 2019.

### Process

The data for this study were obtained through the Hawk-Eye system. This system, which has been validated in previous research,<sup>17,30</sup> consists of ten cameras that record at a frequency of 50 to 60 Hz. It allows the tracking of coordinates of the ball and the players during the points in four dimensions (time and Cartesian dimensional coordinates). From this information, the system makes it possible to calculate different kinematic and descriptive variables (for example, the position of the ball bounce or the position of the serving player). In addition to the Hawk-Eye system, a template was created in Microsoft Excel version 16.16.7 (Microsoft, Redmond, USA) to process the data and calculate the variables of interest. The variables obtained were the following:

- Type of serve: It indicates whether the point has started with a first or second serve.
- Effectiveness: It indicates if the point has been won by the serving team without the serve having been returned.
- Side: It indicates whether the serve was hit from the “deuce” side or from the “ad” side of the court.
- Direction: It indicates the zone to which the serve is hit. The values of this variable could be “Wide” (W) (from the singles side line up to 1.37 metres inside the serve box), “Body” (B) (1.37 meters from the

singles side line up to 1.37 meters from the serve centre line) and “T” (T) (from the serve centre line to 1.37 meters within the serve box).<sup>28,31</sup> Figure 1 depicts the zones included in this variable.

### Statistical analysis

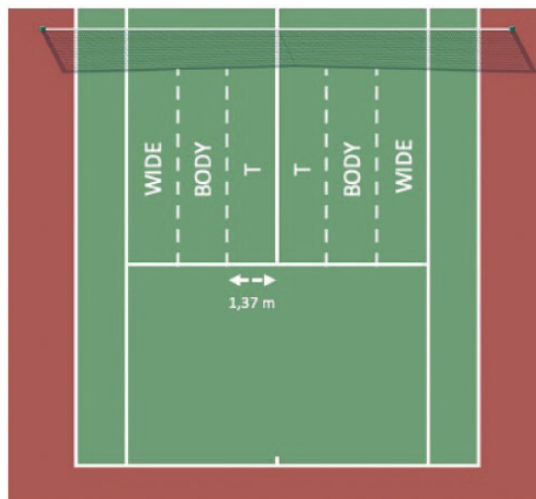
The statistical package SPSS version 26 (SPSS Inc., Chicago, Illinois, USA) was used to carry out the statistical analysis. The Kolmogorov-Smirnov test showed that the variables presented deviations from normality, therefore, non-parametric statistics were used. The Chi square test was used to examine the differences between the different variables. Significant differences were considered to exist as long as the significance level was less than 0.05.

### Results

Table 1 shows the differences between DC and BJKC in terms of the direction of the first serves on both sides of the court. The most common serve direction in both DC and BJKC matches on both sides of the court was towards the zone T. No significant differences were found between the serve directions to the deuce side ( $\chi^2 = 4.316$ ,  $p = .116$ ). However, differences were found in the ad side, since there was a higher percentage of serves to zone W in DC than in BJKC matches, and a higher percentage of serves to the T zone on BJKC than in DC matches ( $\chi^2 = 7.920$ ;  $p = .019$ ).

As per the second serve (Table 2), the most commonly used direction for both DC and BJKC matches was the B zone. When comparing between the two events, significant differences were found on both sides of the court. Specifically, on the deuce side in DC matches, a higher percentage of serves were made to zone T than in BJKC ones, where a greater number of serves were made to zone B and to zone W ( $\chi^2 = 10.534$ ;  $p < 0.05$ ). On the advantage side, in BJKC matches, there was a higher percentage of serves directed to zone B than in DC matches, while in DC matches the percentage of serves to zone T was higher ( $\chi^2 = 7.084$ ;  $p < 0.05$ ) than in BJKC matches.

Regarding the effectiveness of the first serve, the percentage of points won in DC matches was higher than in BJKC regardless of the direction (Table 3). However, with regards to the second serve (Table 4), although a greater effectiveness on both sides was found in DC matches, when comparing each of the directions, significant differences were only found in serves directed to the zone B on the advantage side ( $\chi^2 = 4.575$ ;  $p < 0.05$ ). It is also worth mentioning that, although the difference is not significant ( $p = 0.082$ ), a clear trend could be observed in serves directed to the T zone on the advantage side.



**Figure 1.** Representation of the zones of the variable “Direction”.

### Discussion

The serve is the shot that starts the points in tennis. It is the first opportunity for the players to take advantage and control the point from the beginning.<sup>32</sup> Generally, the first serve could be considered as the tool the serving team can use to build an attacking situation. Therefore, it could be expected that servers would take a greater risk by directing their serves to zones W and T in the service box, since these are the zones furthest from the receiver and, therefore, they would make their return more difficult.<sup>33</sup> Furthermore, the serves directed to the T zone reduce the receiver’s options to return by opening angles and, therefore, provide the server’s partner more options to use a poaching movement and intercept the return at the net and close the point. On the contrary, the second serve, although it can also allow the serving team to take the initiative in the point, implies a greater risk since a mistake with this shot means the loss of the point. Therefore, it could be assumed that a greater percentage of serves were directed to zone B, since this central zone allows for a greater margin of error. The results obtained in this study have shown that, in general, the most used direction with the first serve, both in DC and in BJKC matches, is to the T zone followed by serves directed to the W zone on both sides of the court. This result is similar to that found in a previous study on singles tennis.<sup>29</sup> On the other hand, the strategy followed by the players with the second serve was totally different. Zone B was the one to which a greater percentage of serves was directed. These results show noteworthy differences with respect to previous studies in singles tennis, especially

**Table 1.** Differences in the directions of the first serves in DC and BJKC matches.

		W	B	T	$\chi^2$	p
Deuce	DC	33.0%	26.1%	40.9%	4.316	.116
	BJKC	32.5%	28.1%	39.4%		
Advantage	DC	34.2%	28.7%	37.1%	7.920	.019 <sup>a</sup>
	BJKC	31.9%	27.9%	40.2%		

<sup>a</sup>Significant differences between DC and BJKC in W and T.

**Table 2.** Differences in the directions of the second serves in DC and BJKC matches.

		W	B	T	$\chi^2$	p
Deuce	DC	23.3%	43.1%	33.6%	10.534	.005 <sup>a,b</sup>
	BJKC	24.8%	46.8%	28.4%		
Advantage	DC	23.7%	42.9%	33.4%	7.084	.029 <sup>b</sup>
	BJKC	22.2%	47.3%	30.4%		

<sup>a</sup>Significant differences between DC and BJKC in W and T.

<sup>b</sup>Significant differences between DC and BJKC in C and T.

**Table 3.** Differences in effectiveness for each of the directions of the first serves between DC and BJKC matches.

		Total			W			B			T		
		%	$\chi^2$	p	%	$\chi^2$	p	%	$\chi^2$	p	%	$\chi^2$	p
Deuce	DC	36.1%	273.919	.000	40.1%	143.955	.000	29.8%	33.071	.000	37.0%	106.355	.000
	BJKC	19.1%			18.0%			19.0%			20.0%		
Advantage	DC	34.6%	141.804	.000	38.1%	61.389	.000	27.7%	6.133	.013	36.9%	92.725	.000
	BJKC	21.7%			22.8%			22.9%			20.0%		

**Table 4.** Differences in the effectiveness for each of the directions of the second serves between DC and BJKC matches.

		TOTAL			W			B			T		
		%	$\chi^2$	p	%	$\chi^2$	p	%	$\chi^2$	p	%	$\chi^2$	p
Deuce	DC	25.1%	5.123	.024	26.5%	2.026	.155	24.8%	2.597	.107	24.5%	17.661	.377
	BJKC	21.8%			22.2%			21.4%			22.1%		
Advantage	DC	24.4%	10.053	.002	23.0%	2.336	.126	24.2%	4.575	.032	25.7%	13.182	.082
	BJKC	19.9%			18.6%			19.8%			21.2%		

regarding the directions of the second serves in the male events, where the players directed a greater number of serves to the T zone in the deuce side and to the W zone on the advantage side.<sup>31,33</sup> While in the singles game the players choose to serve to the weak side of the opponent, generally the backhand, in the doubles game the players preferred to take less risks and prevent the receivers from directing the return of serve to the alleys and opening greater angles.

As per the differences between the directions of the first serves in DC and BJKC matches, the results of this study have shown that, on the advantage side, male teams in DC directed a higher percentage of serves to zone W, while female teams in BJKC opted for a higher

percentage of serves directed to zone T. Possibly, the fact that women tend to serve more frequently with less topspin effect to achieve greater speed,<sup>29</sup> causes their percentage of serves to the zone W decrease. This same reasoning, together with the tactical intention of taking a lower risk, can explain the differences with the second serves on the deuce side, where in the BJKC matches a greater number of serves were directed to zones W and B compared to the DC matches, where the number of serves to zone T was greater. On the advantage side, in BJKC matches the female players directed a higher percentage of serves to zone B than did the male players in DC matches, where more serves were directed to zone T. Again, it can be seen how the players choose

to direct their serves to the safest zone, which can help to make fewer mistakes and, furthermore, if the second serve is well executed, it can assist to neutralise the attacking return or force the error of the returners.<sup>32</sup>

The serve in doubles tennis is possibly the stroke that has the greatest relevance in terms of finishing the point. Martínez-Gallego et al.<sup>20</sup> concluded that approximately 30% of the points in men's doubles matches ended with aces or with serves that forced the error of the receiving team. The results obtained in this study confirm these previous results, since in DC matches the effectiveness of the first serves was around 35%, and that of the second serves around 25%. Furthermore, as expected, the effectiveness of the serve of female teams in BJKC matches was significantly lower than that of male teams in DC matches, which confirms the results obtained in previous studies.<sup>19</sup> These differences are mainly explained by the higher serve speed in men's tennis,<sup>17</sup> generated by aspects such as a greater explosive power<sup>34</sup> greater power on the internal rotation of the shoulder<sup>35</sup> in the case of men as compared to women, as well as to technical differences such as the leg drive<sup>36</sup> and the internal rotation of the shoulder<sup>37</sup> and morphological differences as hip and shoulder width.<sup>38</sup>

Regarding the effectiveness of the serve related to its direction, with the first serve male teams in DC matches showed greater effectiveness than female teams in BJKC regardless of its direction. This confirms that, as previously indicated, the differences in effectiveness between genders in doubles tennis are mainly caused by physical and technical factors, and not by tactical aspects related to the direction used by the players. In fact, the results were completely different for the second serve, where no differences were found on the deuce side for any of the directions. On the advantage side, male teams in DC matches were more effective than female teams in BJKC matches when they served the zone B. The fact that players tend to use less offensive strategies with the second serve than with the first serve,<sup>32</sup> makes the speed of the serve less relevant and, therefore, reduces the differences in serve effectiveness between men and women.

## Conclusions

The results of this study have shown that, in both DC and BJKC matches, players took a greater risk with the first serve by serving to zones W and T, possibly trying to move the opponent off position and to take the

initiative of the point. The fact that the topspin effect helps to direct the serve to zone W on the advantage side, and in women's tennis it is frequent to serve with less topspin effect to achieve a greater speed, could be the reasons why in BJKC matches, more serves were directed to the T zone as compared to the DC matches, where zone W was the one that received more serves. Regarding the second serve, the most frequent zone of serve direction was B, both in DC and in BJKC matches, which indicates that the teams took less risks with the second serve. On both sides, male teams served to zone T more frequently as compared to female teams, who opted for zones W and B on the deuce side, and zone B on the advantage side. Therefore, in general, women's teams tended to assume fewer risks than men's ones. The effectiveness of female teams in BJKC matches was significantly lower than that of male teams in DC matches. Depending on the directions, with the first serve, the male teams showed greater effectiveness than the female teams independently of the direction of the serve. On the second serve, they were only more effective than the female teams on the advantage side when they served the zone B. When players adopt less offensive strategies with the second serve by reducing the speed of the serve, the differences in serve effectiveness between men and women are reduced. This study provides new information on the specific characteristics of the serve in men's and women's professional tennis doubles. These data have special importance for coaches and practitioners since it allows them to base the design of the specific doubles training sessions and the strategic planning of doubles matches on quantitative and reliable information. The main limitation of this work is given by the fact that the serve is analysed in isolation. Future research could consider the analysis of the serve together with the sequence of shots that follow (i.e. return of serve, second shot of the server, etc.), which would provide more information on the use and effectiveness of the different patterns of play used by teams in the doubles game.

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