

# How the Court Surface Influences the Number of Grand Slams a Player Can Achieve

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Court surface in tennis is defined by court speed with grass (used at Wimbledon) being the fastest surface, followed by hard court (with the US Open being typically faster than the Australian Open - both hard court surfaces) and clay (used at the French Open) being the slowest surface. Each player is best suited to a particular court surface, with Federer performing best on grass, Djokovic on hard court and Nadal on clay. This is indicated by table 1 with Federer winning the most number of Wimbledon titles, Nadal winning the most number of French Open titles and Djokovic winning the most number of Australian Open titles.

	Federer	Nadal	Djokovic
Wimbledon	8	2	5
US Open	5	4	3
Australian Open	6	1	7
French Open	1	12	1
	<b>20</b>	<b>19</b>	<b>16</b>

Table 1: Number of grand slams wins for Federer, Nadal and Djokovic

There is a natural ordering in performance based on court speed relative to a player's best surface (for example Federer that performs best on grass at Wimbledon would achieve the next best result at the faster hard court surface at the US Open). Based on the court surface there is a natural bias towards the number of grand slams a player can achieve, such that a player that performs best on hard court has a greater opportunity to win more grand slams than players that perform best on grass or clay. This is proven as follows.

Given 3 equal players such that player 1 performs best on grass, player 2 performs best on hard court and player 3 performs best on clay. Suppose player  $i$  wins 62% of points on serve on their best surface, 61% of points on serve on their next best surface and 60% of points on serve on their next best surface in terms of court speed. Suppose player  $i$  wins a percentage of points on return of serve relative to the percentage of points won on serve to their opponent (player  $j$ ) on a particular surface. Tables 2, 3 and 4 provide the chances of player  $i$  winning a match against player  $j$  on court surfaces of grass, hard court and clay respectively. The calculations are based on a Markov Chain model in a best-of-5 all tiebreak set match assuming constant probabilities of players winning a point on serve.

	Player 1	Player 2	Player 3
Player 1		56.3%	62.6%
Player 2	43.7%		56.4%
Player 3	37.4%	43.6%	

Table 2: Chances of player  $i$  winning a match against player  $j$  on grass

	Player 1	Player 2	Player 3
Player 1		43.7%	50.0%
Player 2	56.3%		56.3%
Player 3	50.0%	43.7%	

Table 3: Chances of player i winning a match against player j on hard court

	Player 1	Player 2	Player 3
Player 1		43.6%	37.4%
Player 2	56.4%		43.7%
Player 3	62.6%	56.3%	

Table 4: Chances of player i winning a match against player j on clay

Table 5 calculates the probabilities for player i winning two matches (one against each other player j) for a particular surface. These probabilities are then summed to give an objective probability as to which player i has an advantage by performing best on a particular surface. As expected, player 1 and player 3 have equal chances of winning the same number of grand slams (value of 0.734). However, player 2 has an advantage of winning more grand slams than player 1 and player 2 (value of 0.810) based on being best suited to hard court.

	Grass	Hard Court	Clay	Total
Player 1	$56.3\% \times 62.6\% = 0.352$	$43.7\% \times 50.0\% = 0.219$	$43.6\% \times 37.4\% = 0.163$	0.734
Player 2	$43.7\% \times 56.4\% = 0.246$	$56.3\% \times 56.3\% = 0.317$	$56.4\% \times 43.7\% = 0.246$	0.810
Player 3	$37.4\% \times 43.6\% = 0.163$	$50.0\% \times 43.7\% = 0.219$	$62.6\% \times 56.3\% = 0.352$	0.734

Table 5: Probabilities for player i winning two matches (one against each other player j) for a particular surface

It appears that Nadal (currently on 19 slams and age of 33) will overtake Federer in total grand slams (currently on 20 slams and age of 38) even though Nadal performs best on clay (this is a result of Nadal winning a current record 12 French Open titles). Djokovic (currently on 16 slams at the age of 32) who performs best on hard court has an advantage on the tour to win more grand slams than Federer and Nadal – however Djokovic didn't win his first grand slam until the age of 21 at the 2008 Australian Open. Nadal won his first grand slam at the age of 19 at the 2005 French Open. Further, the lack of grass court tournaments available in comparison to hard court and clay tournaments on the ATP tour means that players that are best suited to grass such as Federer are disadvantaged.