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Entering tennis men's Grand Slams within the top-10 and its relationship with the fact of winning the tournament

Acceder a los Grand Slams de tenis masculino desde el top-10 y su relación con el hecho de ganar el torneo

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Abstract

The purpose of this study was to analyse the relationship between entering tennis men's singles Grand Slams within the top-10 ranking (i.e. title favourites) and the fact of winning the tournament. In order to differentiate between these players in a more powerful way than just considering the ranking number, a cluster algorithm was used to classify the players into two groups depending on their number of ranking points (i.e. higher level top-10 players vs. lower level top-10 players). The possible winners entering the tournament outside the top-10 (if any) were also considered. The sample comprised all the 92 men's singles Grand Slams played between 1990 and 2012. As was expected, the majority of Grand Slams were won by players entering the tournament ranked in the top-10. However, the main result is contrary to the hypothesis that there would be significant differences in the number of titles won in favour of the players entering the tournament from the higher positions of the top-10 when comparing to those won by the players entering from the lower positions of the top-10. Several factors that may influence whether and to what extent a player is more or less favourite to win a Grand Slam title are presented in the discussion.

Key words: ATP world tour, professional tennis, performance analysis, top-10 ranking.

Resumen

El propósito del estudio fue analizar la relación entre acceder a los Grand Slam de tenis masculino desde el top-10 del ranking (favoritos al título) y el hecho de ganar el torneo. Con el objeto de diferenciar a estos jugadores de una forma más potente que simplemente considerando su número de ranking, se empleó un algoritmo cluster que clasificó a los jugadores en dos grupos en función del número de puntos de ranking (jugadores de mayor nivel dentro del top-10 v. jugadores de menor nivel del top-10). Los posibles ganadores del torneo accediendo al mismo desde posiciones fuera del top-10 (si los hubiera) fueron también considerados. La muestra comprendió los 92 torneos de Grand Slam masculinos jugados entre 1990 y 2012. Según lo esperado, la mayoría de Grand Slams fueron ganados por jugadores que accedieron al torneo dentro de los diez primeros clasificados del ranking. Sin embargo, el principal resultado es contrario a la hipótesis de que existirían diferencias significativas entre el número de títulos ganados en favor de los jugadores que accedían a los torneos desde las primeras posiciones del top-10 cuando se comparan con aquellos títulos ganados por los jugadores que accedían desde las posiciones más bajas del top-10. Múltiples factores que pueden influir en el hecho de que un jugador sea más o menos favorito para ganar un torneo de Grand Slam son discutidos.

Plabras clave: circuito ATP, tenis profesional, análisis del rendimiento, ranking top-10.

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Introduction

Distributed throughout the season, the four Grand Slams (i.e. Australian Open, French Open, Wimbledon, and US Open) are the most important tournaments in men's professional tennis and those that award more points for the ATP (Association of Tennis Professionals) ranking. The ATP ranking indicates the competitive level of each tennis player and is used as the 'objective merit-based method for determining qualification for entry and seeding in all the tournaments' (ATP rules), hence including the Grand Slams. Men's singles Grand Slams are played over a period of two weeks (instead of the typical one-week period), best of five sets (instead of the best-of-three format used by most other tournaments) with a 128-players draw (instead of the 64- or 32-players standard draws) and they are regarded as the most competitive tournaments, where it is more difficult to win the title (Del Corral, 2009).

The career of the tennis players can be evaluated in relation to their rise in the ATP ranking and the achievement of several ranking milestones that show their progression (e.g. reaching the top-100, top-50, top-20, top-10) (Reid, Morgan, Churchill, & Bane, 2014). In particular, reaching the top-10 is an important milestone that demonstrates a very high tennis level (i.e. being among the 10 best tennis players in the world). Specifically, reaching the world No. 1 ranking is available to very few and guarantees a seat in the history of tennis (i.e. at the date of 2011 only 25 male players have achieved it –since the introduction of the ATP ranking in 1973–; Reid & Morris, 2011). It is therefore that players ranked in the top-10 are title favourites in almost every tournament that they play in, attracting great attention from public and media. In this sense, theoretically, the weekly ATP ranking for entries and seeding in one specific tournament orders the players from more favourites to less favourites for the title, with the player holding the No. 1 ranking as the top candidate. In particular, the greater the ranking difference between two opposing players, the higher the probability of winning for the top ranked player, which decreases in matches between two low ranked contenders (Del Corral & Prieto-Rodríguez, 2010). Nonetheless, it should be noted that two players in the top-10 (or in any other ranking position) can be differentiated in only one ranking position but differ in a high number of ranking points, whilst two other players also separated by only one ranking position may differ in a very small number of ranking points. This would indicate there is an important level difference between the first two players at that point of the season, always bearing in mind that the two are great players positioned in the top-10, whereas the other two have a very similar level, at least in terms of ranking points earned/loosed in the last year (i.e. the ATP ranking period is the immediate past 52 weeks, except for the ATP Masters Finals and the Futures Series Tournaments).

The ATP ranking has been used as a predictor of performance in tennis (Bane, Reid, & Morgan, 2014). Previous research has examined, for example, the link between junior boys' and girls' success in the International Junior Circuit and their subsequent progress through the professional ranks (Reid, Crespo, Santilli, Miley, & Dimmock, 2007, for boys; Reid, Crespo, Santilli, 2009, for girls). These studies showed the achievement of a top-20 junior rank as a good milestone for future success, although this relationship is not always a necessary precondition for latter professional success (Brouwers, De Bosscher, & Sotiriadou, 2012). Furthermore, several studies have used mathematical models to try to predict tennis matches outcome in different type of tournaments, not only at the beginning of a match (e.g. Kuper, Sierksma, & Spieksma, 2014; Scheibehenne & Brofer, 2007), but in particular when the match is in progress (e.g. Klaassen & Magnus, 2003; O'Donoghue & Brown, 2008). Yet,

despite the existence of these types of studies, the use of rankings in the evaluation of professional tennis players is still considered a rich but underused source of information (Reid, et al., 2014). In particular, and to the best of our knowledge, no previous work has specifically examined the effect of reaching the week of beginning of tennis Grand Slams tournaments among the 10 best tennis players in the world (i.e. title favourites) and the fact of clinching the title. Therefore the aim of the present study was to analyse the possible relationship between entering tennis men's singles Grand Slams within the top-10 ranking and the fact of winning the tournament. We expected to find that the majority of Grand Slams would be won by the players entering the tournament within the first 10 positions of the ATP ranking. Moreover, we hypothesised to find significant differences in the number of Grand Slams titles won in favour of the players entering the tournament within the higher positions of the top-10 (in terms of ranking points) compared to those won by the players entering from the lower positions of the top-10.

Methods

Sample and data collection

The local Institutional Review Board approved this study. The number of points of the 10 best ranked players in the ATP ranking (top-10) in the week of beginning of each of the four Grand Slams between 1990 (when the current ATP points system was incepted) and 2012 were retrieved, for a total of 23 seasons and 92 Grand Slams under analysis. The player who came out as the winner in each one of these Grand Slams under analysis was recorded. The number of points of the top-10 end-of-year ranked players in each of the seasons under analysis was also retrieved. Thus, a total of 1,150 records were gathered for analysis. Data were obtained from the official ATP Tour website (www.atpworldtour.com).

Procedures

In a first step, with the aim of differentiating between the top-ranked players in the top-10 in a more powerful way than just considering the ATP ranking number, a *k*-means cluster classification algorithm was used. The cluster divided the players in the top-10 into two groups depending on their number of ranking points: one first group containing the players with more ranking points within the top-10 (higher level top-10 players) and one second group containing the players with less ranking points (lower level top-10 players). In this way and as was argued in the introduction section, the classification algorithm *prevents* that two top-10 players separated by only one ranking position but a large number of ranking points are considered within the same group, strengthening the classification system used in the study. Moreover and in order to consider potential Grand Slam winners entering the tournament outside the top-10, one third group that would house these players (if any) was considered. In a second step, the number of players (*n*) who came out as winners entering the Grand Slams from each one of the three groups under analysis (i.e. higher level top-10 players, lower level top-10 players, players outside the top-10) were computed. The frequency distributions (%) on the total winners were then calculated. In addition, the particular case of the player holding the No. 1 ranking (which will always be among the higher level top-10 player/s) was taken into account.

Statistical analysis

For the purpose of analysis, descriptive data and inferential analyses using crosstabs were computed. The Pearson's Chi-square test was calculated to compare the obtained frequencies

of winners between the groups under study. When meeting an expected frequency distribution (*EFD*) below 5 the Fisher's exact test on the value of the Chi-square test was applied. The effect sizes (*ES*) were calculated using the Cramer's V test and their interpretation was based on the following criteria: 0.10 = small effect, 0.30 = medium effect, and 0.50 = large effect (Cohen, 1988). The significance level was set at $P \leq 0.05$. The statistical package SPSS version 21.0 (IBM Corp., Armonk, NY, USA) was used for the analyses.

Results

Table 1 presents the number and frequency of winners when examining the differences between the players entering the Grand Slams within the higher or lower positions of the top-10 in terms of ranking points (i.e. higher level top-10 players vs. lower level top-10 players) or outside the top-10. Of the total of Grand Slams under analysis, 84.78% were won by players entering the tournament within the first 10 positions of the ranking (top-10 players). In particular, 61.96% were won by players entering from the higher positions of the top-10 (1st cluster) and 22.83% won by players entering from the lowest positions of the top-10 (2nd cluster). The remaining 15.22% of Grand Slams titles were won by players reaching the tournament outside the top-10. The results of the statistical analyses did not show any significant differences in the number of Grand Slams won when comparing exclusively higher level top-10 players to lower level top-10 players (χ^2=5.928, df=3, *P*=0.125, *EFD*=8.75, *ES*=0.26) nor when incorporating into the analysis the Grand Slam titles won by those players entering the tournament outside the top-10 (χ^2=10.312, df=6, *P*=0.101, *EFD*=3.50, *ES*=0.24). There were no significant differences between the four Grand Slams either (*P*>0.05). That is, no statistically significant differences were found in the number of titles won by the players entering the Grand Slams within the higher positions of the top-10 in comparisons to those won by the players entering these tournaments from the lower positions of the top-10 or outside the top-10.

Table 1. Case numbers (*n*) and frequency distribution (%) of winners entering the Grand Slams (GS) within the higher or lower positions of the top-10 or outside the top-10. The particular cases of the players holding the No. 1 ranking are presented in parentheses.

Entering	Australian Open		French Open		Wimbledon		US Open		All the GS	
ranking	*n*	%	*N*	%	*n*	%	*n*	%	*n*	%
Higher top-10	14(10)	60.87	10(3)	43.48	18(11)	78.26	15(7)	65.22	57(31)	61.96
Lower top-10	8	34.78	7	30.43	2	8.70	4	17.39	21	22.83
Outside top-10	1	4.35	6	26.09	3	13.04	4	17.39	14	15.22

Table 2 shows the players who win the tournament entering outside the top-10 in each of the four Grand Slams (15.22% out of the total winners). In particular, 78.57% of these were among players ranked between the 11th and 20th position of the ATP ranking (i.e. players in the top-20). Only three players won a Grand Slam title entering the tournament outside the top-20: Gastón Gaudio ranked No. 34 in French Open 2004, Gustavo Kuerten ranked No. 66 in French Open 1997, and Goran Ivanišević ranked No. 125 in Wimbledon 2001 as the player who won a men's singles Grand Slam title with the lowest ranking in the ATP history. There are also other special cases which deserve to be highlighted. This is, for example, the case of Spain and the French Open, in which three players won the tournament entering outside the top-10 (Sergi Bruguera in 1993, Carlos Moyà in 1998, and Albert Costa in 2002). It also highlights the three US Open championships won by US players (country where the

tournament is held): Andre Agassi in 1994 and Pete Sampras twice in 1990 and 2002. Also noteworthy is the case of US player Andre Agassi who won three of his eight Grand Slam titles entering the tournament outside the top-10 (Wimbledon in 1992, US Open in 1994, and French Open in 1999). With respect to the temporal distribution of winners entering outside the top-10, 64.28% (*n*=9) of the total were in the period between 1990 and 2001, compared to 35.72% (*n*=5) in the period between 2002 and 2012.

Table 2. Grand Slam winners entering the tournament outside the top-10.

Player	Country	Entering ranking	Year
Australian Open			
Thomas Johansson	Sweden	18	2002
French Open			
Sergi Brugera	Spain	11	1993
Gustavo Kuerten	Brazil	66	1997
Carlos Moyà	Spain	12	1998
Andre Agassi	USA	14	1999
Albert Costa	Spain	22	2002
Gastón Gaudio	Argentina	34	2004
Wimbledon			
Andre Agassi	USA	14	1992
Richard Krajicek	Netherlands	13	1996
Goran Ivanišević	Croatia	125	2001
US Open			
Pete Sampras	USA	12	1990
Andre Agassi	USA	20	1994
Patrick Rafter	Australia	14	1997
Pete Sampras	USA	17	2002

Figure 1 shows the distribution of the end-of-year ranking positions within the first and second top-10 clusters (i.e. higher level top-10 players, lower level top-10 players) and the number of Grand Slams won by the players who finished the season in these positions. In 75.0% of cases (*n*=69) the players who won one Grand Slam during the season (at least one) finished the year within the higher top-10 ranking positions (i.e. higher level top-10 players; first cluster). In 18.48% of cases (*n*=17) the players who won one Grand Slam (never more than one) finished the season within the lower top-10 ranking positions (i.e. lower level top-10 players; second cluster). In 6.52% of cases (*n*=6) the players who won one Grand Slam (never more than one) finished the season outside the top-10. In particular, 45.65% (*n*=42) of the total Grand Slams under analysis were won by the player ending the year holding the No.1 ranking in the world.

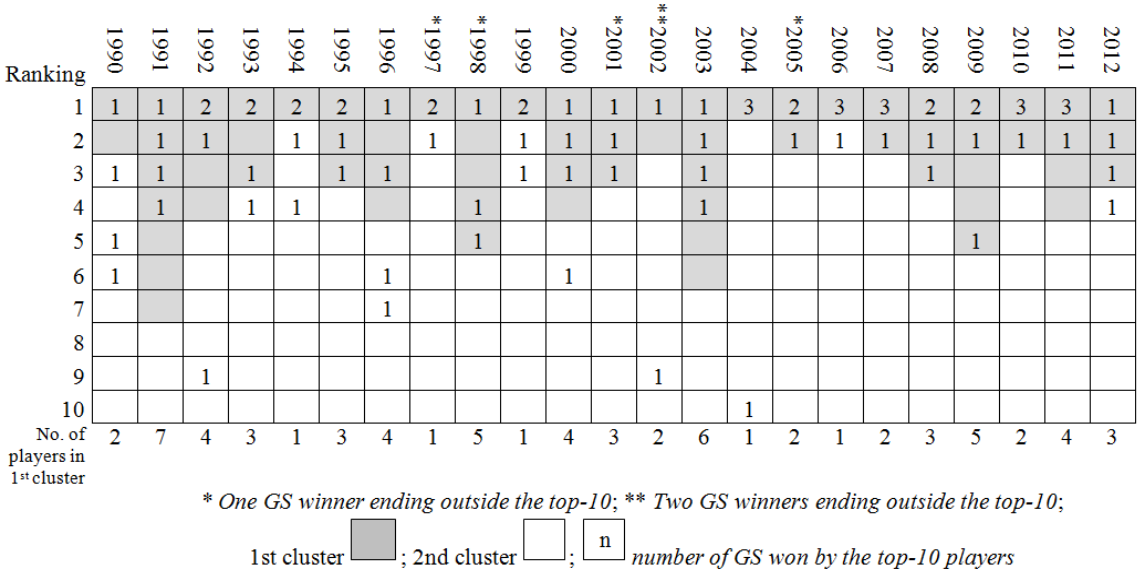

Figure 1. End-of-year ranking distribution within the first and second top-10 clusters (i.e. higher and lower level top-10 players respectively) and number of Grand Slams (GS) won by each of the players who finished the season in the top-10.

Table 3 shows the players who won a Grand Slam title and finished the season outside the top-10. It highlights the case of three players who won the Australian Open and ended the season outside the top-10: Petr Korda in 1998, Thomas Johansson in 2002, and Marat Safin in 2005.

Table 3. Grand Slam winners ending the year outside the top-10.

Player	Country	Grand Slam	End-of-year ranking	Year
Gustavo Kuerten	Brazil	French Open	14	1997
Petr Korda	Czech Republic	Australian Open	13	1998
Goran Ivanisevic	Croatia	Wimbledon	12	2001
Pete Sampras	USA	US Open	13	2002
Thomas Johansson	Sweden	Australian Open	14	2002
Marat Safin	Russia	Australian Open	12	2005

Discussion

The purpose of this study was to analyse the relationships between reaching the week of beginning of men's singles Grand Slams among the 10 best tennis players in the world (i.e. title favourites) and the fact of winning the tournament. To that end, and in order to differentiate between the top-10 players in a more powerful way than just considering the ATP ranking number, a classification algorithm based on clustering was used. The cluster divided the players into two groups depending on their number of ranking points (i.e. higher level top-10 players vs. lower level top-10 players). The possible Grand Slam winners entering the tournament outside the top-10 (if any) were also considered. As was expected, the majority of Grand Slams were won by the players entering the tournament ranked in the top-10. However, the main result is contrary to the hypothesis that there would be significant differences in the number of Grand Slams won in favour of the players entering the tournament from the higher positions of the top-10 in comparisons to those won by the players entering from the lower positions of the top-10. These results underline the high level

of competitiveness of tennis Grand Slams tournaments and suggest that the differences in the ranking points between the top-10 players are not reflected in terms of Grand Slam titles wins. No significant differences were found when the Grand Slams winners entering the tournament outside the top-10 (if any) were incorporated into the analysis either.

Several studies have analysed rankings as predictors of performance in the particular case of tennis Grand Slams. Del Corral and Prieto-Rodríguez (2009) used different probit models to examine whether the differences in rankings between individual players are good predictors for Grand Slam outcomes. The differences in the ATP ranking were highlighted as the most important explanatory variable for predicting outcome in tennis Grand Slams in all the models, and that these ranking differences were more decisive in predicting the probability of victory as moving nearer to the top of the ranking (i.e. increase of 15% in the predicted probability for the 1st ranked player relative to the 11th ranked player vs. increase of 2% when comparing the 51st and 61st players in the ranking). Ma, Liu, Tan and Ma (2013) examined the potential factors that lead to winning matches in men's singles Grand Slams. The authors provided a logistic regression model that predicted the winners in more than 90% of cases and identified specific predictive performance characteristics of match outcomes (e.g. service and return outcomes, stature, time period), among which was included the players' ranking. However, it is difficult to compare findings and generalise conclusions because the discussed studies examined whether the ranking differences were good predictors of Grand Slam matches outcome individually and not globally in terms of winning the tournament. Besides, these studies did not specifically distinguish between the highest or lowest positions of the top-10. Yet, the ranking differences were not accounted in terms of ranking points, but in terms of ranking positions. As stated in the introduction of this paper, two players (e.g. top-10 players) can be differentiated in only one ranking position but differ in a high number of ranking points, whilst two other players (e.g. as well top-10 players) also separated by only one ranking position may differ in a very small number of ranking points. Therefore, the fact of considering uniquely the ranking position may mask the potential real level difference between the players. Hence, it would be valuable to analyse if, for example, the studies discussed above show or not a different effect on the level of forecasting accuracy when considering the differences in terms of ranking points. In this line of work, Clarke and Dyte (2000) computed a logistic regression to estimate each player's winning probability in 1998 men's Wimbledon, 1998 US Open, and 1999 Australian Open as a function of the difference in the players' rating points. The authors used a year's tournament results in a simulation to estimate each player's chance of victory.

At this point it should be noted that, despite the existence of all these tennis ranking based studies (in which the present one is included) and their strong interest among fans and media, men's and women's professional tennis rankings (i.e. ATP and WTA rankings) are also often an issue of controversy. In this sense, Dingle, Knottenbelt and Spanias (2013) highlight the case of Caroline Wozniacki, who held the 1st position in the WTA ranking for 67 weeks (until the date of January 23, 2012) despite not having won a Grand Slam title, in relation to which the former great champion Martina Navratilova (i.e. 18 Grand Slams singles titles) criticised the fact that the ranking weighs too much the amount of tournaments played and not so much the quality of the results in the major tournaments (e.g. Grand Slams). For this reason some authors have proposed and/or discussed alternative tennis ranking systems in which the raking of each player is calculated and/or adjusted using different mathematical techniques (e.g. Breznik, 2015; Dahl, 2012; Radicchi, 2011).

Besides the ranking, several other factors that could influence whether and to what extent a player is more or less favourite to win games in one specific tournament (e.g. Grand Slams), and ultimately to win the title, may contribute to explain the results. These may include, but are not limited to: the player's latest tournament results (e.g. whether the player is coming from a positive or negative run of results); the player's results in the latest editions of the tournament (i.e. whether the player had good results in the past or not); the possible cumulative fatigue after periods of consecutive matches and/or tournaments (Hornery, Farrow, Mujika, & Young, 2007; Goossens, Kempeneers, Koning, & Spieksma, 2015) and the potential negative jet lag effects after traveling across multiple time zones to compete in a tournament (Pluim & Crespo, 2001); the type of surface on which the tournament is played (i.e. Australian and US Open on hard courts, French Open on clay, Wimbledon on grass) and how it affects player's performance (Barnett & Pollard, 2007; Tudor, Zecic, & Matkovic, 2014); the type of tournament (e.g. Grand Slams, Masters, etc.) and number of ranking points awarded, which in terms of computing the players ranking is defined as the highest number of points earned in the tournament (Dingle, et al., 2013); and the tournament draw that determines who gets to play whom (i.e. head to head record with the next opponent and possible rivals to face in subsequent rounds of play).

The interaction between the aspects mentioned above and the favourite status based on the ranking may result in a subjective perception of skills by the players, which can be related to their level of motivation and perceived ability (Csikszentmihalyi, 1988). When this motivation and perceived ability is high, it can lead to an experience of flow in the players, which may have a positive impact on their performance (Marsh & Jackson, 1999; Koehn & Morris, 2014). Other formal terms for these beliefs of self-efficacy and high confidence levels include the hot hand phenomenon and psychological momentum (Little, 2014), which can be defined as the added advantage obtained when initial success leads to a greater likelihood of future success in the sporting context (Gayton, Very, & Hearns, 1993). These concepts have been extensively studied in sports sciences and are still being revisited by different authors (Arkes, 2010; Iso-Ahola & Dotson, 2014). Nonetheless, the existing literature regarding the intriguing processes underlying these complex phenomena is still inconclusive (Avugos, Köppen, Czienskowski, Raab, & Bar-Eli, 2013) and controversial on whether its existence is real or fictitious (Crust & Nesti, 2006). Conversely, research has highlighted the fact that athletes who have enjoyed previous success and turn into favourites in a competition may face major additional demands, which can make them susceptible to choke under that favourite status pressure (Baumeister, 1984; Hill & Shaw, 2013). For example, Jordet (2009) found that football players were less successful from the penalty spot and choked under the pressure of high scoring expectations after gaining a superstar status by receiving one or several major international awards (e.g. FIFA World Player of the year, *Ballon d'Or*). In tennis, very interestingly, Bijleveld, Custers and Aarts (2011) found that favourites fail to outclass 'underdogs' in the finals of tennis tournaments in which a lot of money is at stake and the trophy is displayed in their sight. In line with the above reasoning, the authors suggest that this effect can be explained due to the fact that favourites are more vulnerable to choking under pressure by continuously reminding what is at stake. Following this line of reasoning, the results of the present study may suggest that the players situated in the higher positions of the top-10 (in terms of ranking points) choke under the pressure created by their ranking when facing a Grand Slam tournament more often than the rest of the players in the top-10. This possibility, however, must be considered cautiously.

Future research could analyse the issue more closely by, for example, conducting qualitative studies in which top-10 players are asked about their perception of success and psychological state prior to the start of the Grand Slam and then contrast their valuations with the subsequent results in the tournament.

It should be highlighted the case of the players who won a Grand Slam coming into the week of beginning of the tournament ranked outside the top-10. However, most of these cases were players ranked in the top-20. This suggests that, although there may be exceptional cases (e.g. Goran Ivanisevic winning Wimbledon in 2001 ranked 125th), occupying the top-20 positions in the ranking table appears to be essential to winning Grand Slam titles. Once again, the high competitiveness of tennis Grand Slams and the fact that they are the main events of the calendar year for the best players in the world makes it very difficult to clinch the title for lower-level players. Other particular cases deserve to be highlighted. Three Spanish players won the French Open entering the tournament outside the top-10. This may suggest the influence of the surface on which the Paris tournament (i.e. clay) is played. With a great tennis tradition, and because of its good weather throughout most of the year, Spain has a large number of clay courts, giving Spanish tennis players a big plus in clay court tournaments (Lewit, 2014). In fact, Koning (2011) found that Spanish players had an advantage over US players when the match is played on a clay court, because their exposure to this surface is higher. Three US Open were won by US players entering the tournament outside the top-10. This may suggest the influence of the home advantage effect, which can be defined as the "performance advantage of an athlete, team or country when they compete at a home ground compared to their performance under similar conditions at an away ground" (Koning, 2005). Linking these two issues, Koning (2011) found some evidence that the home advantage effect on clay courts is due to experience and home advantage on hard courts is due to the support of the crowd. Andre Agassi, generally considered to be one of the greatest tennis players of all time, won three of his eight Grand Slam titles entering the tournament outside the top-10 (always within the top-20). In addition these were Grand Slams played on different surfaces (Wimbledon, US Open, and French Open). In fact, Agassi was the first male player to win the four Grand Slams on three different surfaces (hard, clay, and grass).

With respect to the temporal distribution of the Grand Slam winners entering the tournament outside the top-10, the results suggest lower level differences between the top-10 and the top-20 players in the period between 1990 and 2001 in comparisons to the period between 2002 and 2012. This latter period coincided with Roger Federer's and Rafael Nadal's most dominant periods. In particular between 2005 and 2010 they alternated the first two positions in the ranking and won 21 out of the 24 Grand Slams played. Finally, it highlights the case of three players who won the Australian Open and ended the season outside the top-10. The Australian Open is the first Grand Slam of the season (beginning in mid-January) and is considered the more definitive start of the tennis season, prior to which only one or two tournaments serve as indicators to judge each player's performance. The start of the season is the time for change and the Australian Open history has shown outsiders more capable of defeating the highest ranked players than in any of the other Grand Slam tournaments (Schooler, 2015). However, the results show the difficulty of maintaining consistency over a full season in the ATP circuit and reflect the problems these players had to continue to reap the great results expected from a Grand Slam winner. In fact, in two of the three cases (Petr Korda and Thomas Johansson) it was the first singles Grand Slam title for these players and ultimately the only one.

In summary, the results underline the high level of competitiveness of tennis Grand Slams and suggest that the differences between the top-10 players are not reflected in terms of Grand Slam titles wins when accounting for the players' ranking points. In addition to the suggestions for future research proposed throughout the discussion, replicating this type of study in lowest category tournaments (e.g. Masters 1000, ATP World Tour 500) and/or adapting the study to other tennis competitive contexts (e.g. women's WTA circuit, doubles tennis, youth and junior circuits, disabled tennis) is potential future work.

References

Arkes, J. (2010). Revisiting the hot hand theory with free throw data in a multivariate framework. *Journal of Quantitative Analysis in Sports*, *6*(1), 1–12. http://dx.doi.org/10.2202/1559-0410.1198

Avugos, S., Köppen, J., Czienskowski, U., Raab, M., & Bar-Eli, M. (2013). The "hot hand" reconsidered: A meta-analytic approach. *Psychology of Sport and Exercise*, *14*(1), 21–27. http://dx.doi.org/10.1016/j.psychsport.2012.07.005

Bane, M. K., Reid, M., & Morgan, S. (2014). Has player development in men's tennis really changed? An historical rankings perspective. *Journal of Sports Sciences*, *32*(15), 1477–1484.

Barnett, T., & Pollard, G. (2007). How the tennis court surface affects player performance and injuries. *Medicine and Science in Tennis*, *12*(1), 34–37.

Baumeister, R. (1984). Choking under pressure: Self-consciousness and paradoxical effects of incentives on skillful performance. *Journal of Personality and Social Psychology*, *46*(3), 610–620. http://dx.doi.org/10.1037/0022-3514.46.3.610

Bijleveld, E., Custers, R., & Aarts, H. (2011). When favourites fail: Tournament trophies as reward cues in tennis finals. *Journal of Sports Sciences*, *29*(13), 1463–1470. http://dx.doi.org/10.1080/02640414.2011.604679

Breznik, K. (2015). Revealing the best doubles teams and players in tennis history. *International Journal of Performance Analysis in Sport*, *15*(3), 1213–1226.

Brouwers, J., De Bosscher, V., & Sotiriadou, P. (2012). An examination of the importance of performances in youth and junior competition as an indicator of later success in tennis. *Sport Management Review*, *15*, 461–475. http://dx.doi.org/10.1016/j.smr.2012.05.002

Clarke, S., & Dyte, D. (2000). Using official ratings to simulate major tennis tournaments. *International Transactions in Operational Research*, *7*, 585–594. http://dx.doi.org/10.1111/j.1475-3995.2000.tb00218.x

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences*. Hillsdale, NJ: Erlbaum.

Crust, L., & Nesti, M. (2006). A review of psychological momentum in sports: why qualitative research is needed. *Athletic Insight Journal*, *8*, 1–15.

Csikszentmihalyi, M. (1988). The flow experience and its significance for human psychology. In M. Csikszentmihalyi, & I. S. Csikszentmihalyi (Eds.), *Optimal experience: Psychological studies of flow in consciousness* (pp. 1536). New York, NY: Cambridge University Press. http://dx.doi.org/10.1017/CBO9780511621956.002

Dahl, G. (2012). A matrix-based ranking method with application to tennis. *Linear algebra and its applications*, *437*(1). http://dx.doi.org/10.1016/j.laa.2012.02.002

Del Corral, J. (2009). Competitive Balance and Match Uncertainty in Grand Slam Tennis: Effects of Seeding System, Gender, and Court Surface. *Journal of Sports Economics*, 10(6), 563–581. http://dx.doi.org/10.1177/1527002509334650

Del Corral, J., & Prieto-Rodríguez, J. (2010). Are differences in ranks good predictors for Grand Slam tennis matches? *International Journal of Forecasting*, *26*, 551–563. http://dx.doi.org/10.1016/j.ijforecast.2009.12.006

Dingle N., Knottenbelt, W., Spanias, D. (2013). On the (page) ranking of professional tennis players. *Computer Performance Engineering*, *4*, 237–247. http://dx.doi.org/10.1007/978-3-642-36781-6_17

Gayton, W. F., Very, M., & Hearns, J. (1993). Psychological momentum in team sports. *Journal of Sport Behavior*, *16*, 121–123.

Goossens, D. R., Kempeneers, J., Koning, R. H., & Spieksma, F. C. R. (2015). Winning in straight sets helps in Grand Slam tennis. *International Journal of Performance Analysis in Sport*, *15*(3), 1007–1021.

Hill, D. M., & Shaw, G. (2013). A qualitative examination of choking under pressure in team sport. *Psychology of Sport and Exercise*, *14*, 103–110. http://dx.doi.org/10.1016/j.psychsport.2012.07.008

Hornery, D.J., Farrow, D., Mujika, I., & Young, W. (2007). An integrated physiological and performance profile of professional tennis. *British Journal of Sports Medicine*, *41*, 531–536. http://dx.doi.org/10.1136/bjsm.2006.031351

Iso-Ahola, S.E., & Dotson, C.O. (2014). Psychological momentum: Why success breeds success. *Review of General Psychology*, *18*(1), 19–33. http://dx.doi.org/10.1037/a0036406

Jordet, G. (2009). When superstars flop: Public status and choking under pressure in international soccer penalty shootouts. *Journal of Applied Sport Psychology*, *21*, 125–130. http://dx.doi.org/10.1080/10413200902777263

Klaassen, F., & Magnus, J. (2003). Forecasting the winner of a tennis match. *European Journal of Operational Research*, *148*, 257–267. http://dx.doi.org/10.1016/S0377-2217(02)00682-3

Koehn, S., & Morris, T. (2014). The effect of performance context and skill level on the frequency of flow experiences. *European Journal of Sport Science*, *14*(S1), S478–86. http://dx.doi.org/10.1080/17461391.2012.718364

Koning, R.H. (2005). Home advantage and speed skating: Evidence from individual data. *Journal of Sports Sciences*, *23*, 417–427. http://dx.doi.org/10.1080/02640410400021625

Koning, R.H. (2011). Home advantage in professional tennis. *Journal of Sports Sciences*, *29*(1), 19–27. http://dx.doi.org/10.1080/02640414.2010.516762

Kuper, G., Sierksma, G., & Spieksma, F. (2014). *Using tennis rankings to predict performance in upcoming tournaments*. (SOM Research Report; Vol. 14034-EEF). Groningen: University of Groningen, SOM research school.

Lewit, C. (2014). The Secrets of Spanish Tennis. *ITF Coaching and Sport Science Review*, *64*(22), 9–10.

Little, B.C. (2014). *The Hot Hand and Psychological Momentum as Adaptive Beliefs in Sport*. Electronic Theses, Treatises and Dissertations. Paper 9033.

Ma, S.M., Liu, C.C., Tan, Y., & Ma, S.C. (2013). Winning matches in Grand Slam men's singles: An analysis of player performance-related variables from 1991 to 2008. *Journal of Sports Sciences*, *31*(11), 1147–1155. http://dx.doi.org/10.1080/02640414.2013.775472

Marsh, H. W., & Jackson, S. A. (1999). Flow experience in sport: Construct validation of multidimensional, hierarchical state and trait responses. *Structural Equation Modeling*, *6*, 343–371. http://dx.doi.org/10.1080/10705519909540140

O'Donoghue, P. G., & Brown, E. (2008). The Importance of Service in Grand Slam Singles Tennis. *International Journal of Performance Analysis in Sport*, *8*(3), 70–78.

Pluim, B., & Crespo, M. (2001). Ten ways to prevent jet lag. *ITF Coaching and Sport Science Review*, *25*, 8–9.

Radicchi, F. (2011). Who Is the Best Player Ever? A Complex Network Analysis of the History of Professional Tennis. *PLoS ONE*, *6*(2): e17249. http://dx.doi.org/10.1371/journal.pone.0017249

Reid, M., Crespo, M., & Santilli, L. (2009). Importance of the ITF junior girls' circuit in the development of women professional tennis players. *Journal of Sports Sciences*, *27*, 1443–1448. http://dx.doi.org/10.1080/02640410903037714

Reid, M., Crespo, M., Santilli, L., Miley, D., & Dimmock, J. (2007). The importance of the International Tennis Federation's junior boys' circuit in the development of professional tennis players. *Journal of Sports Sciences*, *25*, 667–672. http://dx.doi.org/10.1080/02640410600811932

Reid, M., Morgan, S., Churchill, T., & Bane, M. K. (2014). Rankings in professional men's tennis: a rich but underutilized source of information. *Journal of Sports Sciences*, *32*(10), 986–992. http://dx.doi.org/10.1080/02640414.2013.876086

Reid, M., & Morris, C. (2011). Ranking benchmarks of top 100 players in men's professional tennis. *European Journal of Sport Science*, *13*, 1–6.

Scheibehenne, B., & Brofer, A. (2007). Predicting Wimbledon 2005 tennis results by mere player name recognition. *International Journal of Forecasting*, *23*, 415–426. http://dx.doi.org/10.1016/j.ijforecast.2007.05.006

Schooler, A. (2015). Australian Open: A look back at players who have caused surprises at the opening Grand slam of the year. Retrieved from: http://www.skysports.com/tennis/australian-open/news/31851/9644710/australian-open--a-look-back-at-players-who-have-caused-surprises-at-the-opening-grand-slam-tournament-of-the-season

Tudor, P. B., Zecic, M., & Matkovic, B. (2014). Differences between 2010 and 2011 performance indicators of tennis play at the Grand Slam tournaments. *Kinesiology*, *46*(1), 101–106.