

Performance characteristics of a winning polo team

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ABSTRACT

Polo is played globally, and is contested by two teams of four players on horseback. Despite popularity, there is little academic literature assessing Polo players, and what constitutes successful Polo performance. One reason for this may be Polo's unique player rating system, the handicap, which quantifies individuals and teams' level of play. We sought to characterise the play of a tournament winning high-goal polo team (KPF) using percent and raw differences between teams using a customised matrix, which was designed with input from international polo players. Secondly, we assessed the association between player handicap and success rates of key performance metrics. KPF won five of seven games played, with forehand middle (FHM) being the least variable shot (-4 to 5% success rate), whereas long backhand shots were the most variable (-50 to 45% success rate). Fewer turnovers were conceded than the opposition in all games won, and in four out of the five winning games, more penalties were awarded to KPF than their opponents. At an individual level, FHM was significantly correlated to player handicap ($r = 0.562$, Large: $p < 0.05$). Player handicap was also moderately correlated with backhand middle ($r = 0.330$), backhand long ($r = 0.361$), and ride off ($r = 0.362$) success rates. Turnovers and penalties awarded confer clear attacking and goal-scoring opportunities. FHM, backhand shots and ability to contest for the ball (ride off) are key performance metrics, positively associated with player handicap, and higher handicap players demonstrate greater success rates and or less variability than those with lower handicaps. However, variability within players of the same handicap is evident, suggesting subjectivity of the handicapping system.

1. Introduction

Polo is an equestrian based sport played by two teams of four players, on a pitch measuring 270m by 150m. Each player is mounted on horseback and must play right-handed to encourage safety during open play, and when contesting for the right to play a shot, termed 'riding off'. Games are divided into seven-minute periods of play called chukkas; the number of chukkas played depends on the level of play. These naturally occurring breaks between chukkas, or breaks within match play, are often used by riders to change horses. The Hurlingham Polo Association (HPA) regulations state that a horse is not allowed to play in excess of two non-consecutive full chukkas per game or 15 minutes in total, per day (HPA, 2017). Players are assigned handicaps (-2 to +10 Goals), the cumulative total of which depicts the level of play for a tournament (HPA, 2017). Handicap is based on the number of goals the player is worth to the team, with aspects such as

horsemanship, playing skills (individual and team), technique, and the quality of horses being considered (*Polo Handicap: The system explanation*, 2017; HPA, 2017). The area specific Polo association to which the player is registered assigns Player handicap (*Polo Handicap: The system explanation*, 2017).

Britain is largely credited for codifying and expanding the game (*History of Polo*, 2018) through the Hurlingham Club and HPA. However, Argentina is now considered the global hub of Polo, producing the largest number of 10-goal players and hosting three annual high goal tournaments.

Academic literature on Polo players is limited to four papers discussing injury prevalence of play (Clark *et al.*, 2002; Costa-Paz *et al.*, 1999; Innes & Morgan, 2015; Milne, 2011), one editorial (Butwin, 1981), two interviews (Sharma, 2015; Vali, 2009), and one psychological case study of a High Goal player (Chroni, 2011). To contextualise this paucity of literature, there are numerous articles published on conditions pertaining to, and

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performance of Polo horses (Chanda *et al.*, 2017; da Silva *et al.*, 2017; Martin & Allen, 1999; Pfau *et al.*, 2016), which indicates their relative importance within the sport. Whilst these equine outputs are valuable, given the longevity, history and international presence of the game further research into Polo play and Polo players is warranted. This paper aims to quantify the performance of the winning team of a United Kingdom High Goal tournament (KPF), played under HPA rules. A secondary aim of this paper is to identify key performance metrics and correlate these with players' handicaps.

2. Methods

A quantitative analysis of actions performed during play (Table 1) was conducted across a U.K. High Goal (22-Goal) Polo tournament, tracking the performance characteristics of the tournament winning team (KPF), handicapped at 22 goals. This matrix was designed with input from international polo players. Footage was obtained from an online streaming website (Pololine, 2017). Players' actions were tallied and classified as either successful or unsuccessful: success was defined as maintenance of possession (by the rider or a member of the rider's team), or an action that led to a goal being scored. An unsuccessful action was recorded if possession was lost, a penalty conceded or the ball went out of play. The successful completion of an action by a player may also tally an unsuccessful completion from another player. Cumulative data for each game was tallied. Success rates for each action were calculated by dividing the number of successful attempts by the total number of attempts performed (successful + unsuccessful). Differences in success rates between teams were calculated as either percent or raw differences.

Success rates were then correlated against player handicap using the non-parametric Spearman's rank order correlation coefficient within SPSS software (Version 22, IBM, Armonk, NY); accompanying descriptors are included to report the magnitude of correlations (Hopkins *et al.*, 2009). In the instance

that variables return a 0:0 input (successful:unsuccessful), these data points are removed to allow correlations to be calculated. This is less biased than providing a value of either 0 or 1, as technically no data point exists for that action, for that player.

Intra and inter-rater reliability were calculated for this analysis using intraclass correlation coefficient (ICC). Inter-rater reliability was obtained via a two-way mixed ICC, where all games were analysed twice by both researchers. Intra-rater reliability was assessed; games were randomly assigned via random number generator and reliability was calculated by one-way random ICC. Calculations were performed using SPSS software (Version 22, IBM, Armonk, NY) with accompanying qualitative descriptors (Hopkins *et al.*, 2009).

3. Results

KPF won five of the seven games played, with both losses occurring in the group stages (Games 2 and 4; Table 2). Table 2 depicts KPF's percentage and raw differences when compared to the opposition. Small percentage differences were observed between teams for FHM (-4% to 5%); whereas all other shots displayed greater variability, with BHL being most variable (-50% to 45%). Raw differences show fewer turnovers were conceded than the opposition in all games won. Further, in four out of the five games that were won more penalties were awarded to KPF, than their opposition. Further interpretation of the findings can be found within the discussion.

Spearman's rank order correlations between player handicap and success rate ranged from *Trivial* to *Large*, with only one variable (FHM) returning a significant finding ($r = 0.562$, *Large*: $p < 0.05$). Specifically, moderate correlations were returned for BHM ($r = 0.330$), BHL ($r = 0.361$), and RO ($r = 0.362$). Small correlations were observed for Dribble ($r = 0.136$), PEN ($r = 0.165$), and FHL ($r = 0.243$), with TUO only trivially correlated to player handicap ($r = -0.022$).

Table 1: Actions performed by High Goal Polo players

Action	Definition
Dribble	Possession maintained ≤ 2 horse lengths and two or more consecutive contacts with the ball
Forehand Middle (FHM)	> 2 & ≤ 10 horse lengths – player elbow flexing
Forehand Long (FHL)	> 10 horse lengths – player elbow flexing
Backhand Middle (BHM)	> 2 ≤ 10 horse lengths – player elbow extending
Backhand Long (BHL)	> 10 horse lengths – player elbow extending
Penalty Long (PL)	An attacking penalty taken 60 yards from the goal
Penalty Short (PS)	An attacking penalty taken 40 or 30 yards from the goal
Penalty Conceded (PC)	As action
Turnover (TUO)	Possession change following a shot or Ride Off
Ride off (RO)	Fair contest for the ball between two players, in line with the last shot hit
Melee	Coming together of two or more horses from each team

Note: The successful completion of an action by a player may also tally an unsuccessful completion from another player.

Table 2: Comparison of actions performed by KPF and opposing teams.

Action	Game 1	Game 2	Game 3	Game 4	Game 5	Game 6	Game 7
Dribble	-6	-22	1	21	1	-2	20
FHM	0	-3	-2	-4	-3	5	5
FHL	-7	17	-12	-8	16	4	9
BHM	16	-13	-17	1	-14	18	-3
BHL	34	-25	-50	-10	45	-4	12
PL*	0	-1	2	0	1	1	3
PS*	0	0	3	0	0	1	0
PC*	1	-2	7	0	0	2	2
TUO*	-4	4	5	0	-1	-6	-9
RO	9	-14	-27	16	26	8	-11
Melee*	0	3	1	5	-8	-1	-4

Note: Values are expressed as percentages unless asterisked (*), in which case they are expressed as raw differences

Individual player success rates with respect to handicap are reported for variables which produced large (FHM) and moderate (BHM, BHL, RO) correlations, which are reported in Figure 1, panels A,B,C and D, respectively. Across the tournament players with higher handicaps tend to produce greater success rates and/or display less variability (SD) than lower handicapped players.

Inter-rater reliability across all variables ranged from *Small* (0.23) to *Nearly Perfect* (0.94), with a mean reliability of 0.71

(±0.08; *Very Large*) between researchers. Intra-rater reliability demonstrates similar levels of reliability, ranging from *Small* (0.29) to *Nearly Perfect* (0.94). Investigator one had a mean ICC of 0.69 (±0.16; *Large*), with investigator two displaying similar values of 0.72 (±0.16; *Very Large*). Both inter and intra-rater reliability coefficients are reported in Table 3.

Table 3: Inter and Intra-rater reliability of performance metrics across 7 game High Goal Polo tournament

Action	Outcome	Inter-rater ICC	Intra-rater ICC	
			Researcher 1	Researcher 2
Dribble	Successful	0.87	0.89	0.79
	Unsuccessful	0.63	0.68	0.53
FHM	Successful	0.94	0.80	0.91
	Unsuccessful	0.60	0.54	0.62
FHL	Successful	0.83	0.65	0.93
	Unsuccessful	0.70	0.81	0.94
BHM	Successful	0.81	0.71	0.74
	Unsuccessful	0.51	0.59	0.52
BHL	Successful	0.36	0.31	0.82
	Unsuccessful	0.44	0.55	0.77
PL*	Successful	0.23	0.74	0.91
	Unsuccessful	0.80	0.73	0.57
PS*	Successful	0.85	0.87	0.90
	Unsuccessful	1	NM	0.78
PC*	Awarded	0.75	0.86	0.55
	Conceded	0.87	0.78	0.79
TUO*	Received	0.85	0.74	0.70
	Conceded	0.84	0.82	0.70
RO	Successful	0.51	0.55	0.54
	Unsuccessful	0.47	0.29	0.34
Melee*	Successful	0.87	0.80	0.80
	Unsuccessful	0.87	0.80	0.80

Note: ICC values are interpreted to the following magnitudes: *Trivial* <0.1 *Small* 0.1-0.29 *Moderate* 0.30 to 0.49 *Large* 0.50 to 0.69 *Very Large* 0.70 to 0.89 *Extremely Large* ≥0.90. An asterisk (*) indicates that these actions are assessed as raw values not percentage outcomes. NM: No measure.

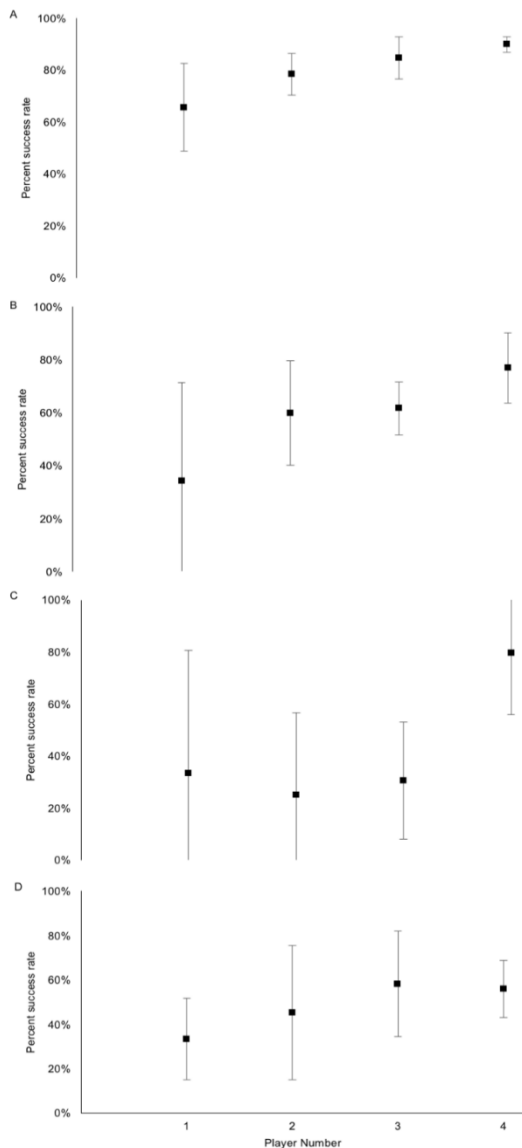


Figure 1: Percent success rates per player, for Forehand Middle (A), Backhand Middle (B), Backhand Long (C) and Ride offs (D). Values are expressed as mean percent success rate \pm standard deviations.

4. Discussion

This is the first paper to quantify Polo performance. Our primary aim was to quantify the performance of the winning team of U.K. Polo tournament; we have done so by calculating percentage and raw differences between the tournament winning team (KPF) and their opposition across the tournament duration for key performance metrics (Table 2), using footage obtained from an online platform (Pololine, 2017). We have shown this method of quantification to be largely reliable within and between researchers. A secondary aim of the paper was to correlate key performance metrics against player handicap, in effect scrutinising the success rates and variability of individual players for those actions most associated to handicap (Figure 1).

The assignment of the Polo handicap is not an exact science, as it is made up of numerous qualitative factors and is awarded by differing regional bodies (Anonymous, 2017). Based upon the apparently subjective nature of the handicap, players assigned the same handicap (goals) may display differences within key performance characteristics when assessed quantitatively. This is evident within our data (Figure 1), with Players 1 and 2, and 3 and 4 possessing the same equal handicaps of 1 and 10 goals respectively. Players 3 and 4 typically display higher success rates and less variability across key performance metrics, in comparison to players 1 and 2. Despite their parity in both being '10-goalers', differences still arise between these players with Player 3 being either more variable (Figure 1 panels A and D) or less successful (Figure 1 panels B and C) than Player 4. Player 4 is currently considered to be one of the best players in the world (Anonymous, 2017); this is supported by our data due to the high success rates and relatively low variability across the seven game tournament. More specifically in one of the most frequently utilised shots (FHM), Player 4 demonstrates a 90% success rate, with only 3% variability (Figure 1 Panel A). This trend is consistent in Players 1 and 2 who also share the same handicap (1 goal): Player 2 has either a higher success rate (Figure 1 panels A, B and D) and or lower variability (Figure 1 panels A, B and C) than Player 1. These differences are more marked than those between Players 3 and 4, suggesting that Player 2 may be under-handicapped, according to our analysis. We acknowledge that the players in the present analysis are from polar ends of the handicap spectrum, in order to draw definitive conclusions with respect to the relationship between success rate and accompanying variability to player handicap, players with handicaps ranging from 2-9 goals need to be included in future analyses.

In reference to the primary aim of the study, despite only respectively *Trivial* and *Small* correlations to individual handicap, turnovers and penalties awarded are apparent key performance metrics. In all five of the games won the winning team conceded fewer turnovers than their opponents, suggesting a superior ability to obtain and maintain possession. Similarly, in four out of five games won more penalties were awarded. In tandem conceding fewer turnovers and obtaining more penalties affords clear attacking and goal-scoring opportunities over the opposition.

Conversely, ride offs appear to show little agreement with match outcome at a team level (Table 2), despite ride off success rate being moderately correlated with individual handicap. An improvement in ride off success rates at the team level would directly influence the number of turnovers obtained by the team, hereby presenting further attacking and goal-scoring opportunities, as suggested above. Ride offs also take place off the ball, however were not quantified in this analysis due to inconsistencies in film and the attacking focus of the footage obtained. Recording of footage that was capable of tracking all players' actions would allow quantification of such potentially important actions. Melees are similarly inconsistent with regards to aligning with match outcome, this could be attributed to the inherent decrease in likelihood of retaining possession when multiple players from both teams contest for the ball. The large playing area and limited player numbers further complicate this; committing players to a melee may in fact expose a team to a counter-attack or increase the likelihood of conceding a penalty.

Backhand shots, irrespective of length, are more variable than all other shots measured, which may be due to the circumstances under which backhands are performed. Researchers observed that this shot tended to be played defensively, often resulting in the ball being cleared and relieving pressure from the opposition; such shots would often result in a turnover despite temporarily alleviating potential goal-scoring opportunities. Adjustment of the matrix to quantify these actions seems intuitive, but is hindered by the fact that researchers could not assess players' intent when playing a shot, regardless of outcome; a matter further complicated by the suggestion that until recently backhand shots were used to facilitate attacking play (B. Kay, personal communications).

As mentioned, forehand shots of 2-10 horse lengths (FHM) are surprisingly consistent between teams, and are significantly correlated with individual player handicap (0.562; *Large*). This suggests a shared importance at the team and individual level for this shot, with the ball hit either to another player or into space at a length where possession can be maintained. As the forehand increases in length (from FHM to FHL), percent success rate becomes more variable (-12% to 17%). There is no apparent trend with match outcome observed for FHL, but the increased variability of this shot in comparison to FHM may point to its serving of differing roles, as proposed for backhand shots.

Dribble success rates presented inconsistent findings when aligned to match outcome. The purpose of a dribble (maintenance of possession within 2 horse lengths) is multi-faceted and may extend to offensive or defensive action, maintaining possession or running down the clock. Our matrix could not account for this variation of intent therefore a more extensive breakdown of the dribble may be required in future studies.

Percentages are commonly employed to identify successful outcomes and performance differences in sports (Atkinson & Nevill, 2001; Hopkins *et al.*, 2009). Whilst convenient and easy to calculate they are descriptive in nature, which may not account for underlying complexities that contribute to their calculation, such as number of shots played or actions performed. This issue could be addressed by adopting a Bayesian statistical approach, which is increasingly recommended within the sport and exercise sciences (Bernards *et al.*, 2017; Mengerson *et al.*, 2016), however, such an in-depth statistical technique was considered beyond the exploratory nature of this work.

As previously mentioned, there is a strong body of research assessing the characteristics of Polo playing horses. We have shown that the match play characteristics of Polo players are variable, which requires support from players' horses to meet the demands of the game (Innes & Morgan, 2015), as behaviours of both player and horse manifest to produce Polo performance (Innes & Morgan, 2015). The individual characteristics of a horse will directly influence a player's ability to achieve the performance metrics outlined in this study, as the horse is the 'vehicle' by which these outcomes are achieved. Horses can be perceived to be a confounding variable, with players required to use multiple horses throughout a game (HPA, 2017). Identification of horses would allow for statistical adjustment within analysis, providing a clearer picture of their contribution to Polo performance.

5. Conclusion

To conclude, turnovers and penalties awarded were shown to be key performance metrics within a tournament winning Polo team, given the attacking and goal-scoring opportunities they confer. It is noted that defensive strategies and play off the ball may also influence team metrics, but these actions were not able to be quantified. Variability within players of the same handicap is apparent, this may be due to the subjectivity of the handicapping system and the dynamic nature of Polo play. Players of a higher handicap demonstrate greater success rates and or less variability than those with lower handicaps. The role of the horse within Polo performance is currently unsubstantiated and warrants investigation.

6. Applications in Sport

We recommend Polo players and teams aim to develop their backhand success rate, whilst conceding fewer penalties than the opposition. This both limits the opposition's time on the ball and increases a team's chances of scoring. The role of melees and ride-offs in the present analysis was unclear as they didn't seem to align with match outcomes. Those players wishing to improve their handicap should start by decreasing the variability and increasing the consistency of their shot play.

Conflict of Interest

The authors declare no conflict of interest.

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