International Journal of Performance Analysis in Sport
2011, 11, 130-141.

The importance of rugby game-related statistics to discriminate winners and losers at the elite level competitions in close and balanced games

Luís Vaz [1], Alain Mouchet [2], David Carreras [3] and Honorato Morente [4]

[1] Research Center for Sport Sciences, Health and Human Development – Portugal
[2] Université Paris Est Créteil - France
[3] Institut Nacional d´Educació Física de Catalunya ; Universitat de Lleida - Spain
[4] Leeds Metropolitan University - Carnegie Faculty of Sport & Education - England

Abstract

The aim of the current study was to identify the Rugby game-related statistics that discriminated between winning and losing teams in International Rugby Board (IRB) competitions (World Cup and Six Nations) and Super Twelve Tournament (S12) in close and balanced games. A cluster analysis was conducted to establish, according to game final score differences, three different match groups. Only the close and balanced games group was selected for further analysis. An analysis of the structure coefficients (SC) obtained through a discriminant analysis allowed the identification of the most powerful game-related statistics in discriminating between winning and losing teams. The results showed that when compared, IRB and S12 close and balanced games were evident, although significant between-games differences were found for all of the analysed group clusters. This suggests that for close and balanced games a general profile may be created, which is probably specific to each team, and may indicate the strengths and weaknesses of that specific competition groups.

Keywords: differences in final game score; performance indicators

1. Introduction

To date, performance analysis in rugby union has not provided comprehensible, objective records of team performance and subsequent form that can be used by coaches in a practical setting. Rugby union is a complex sport whereby performance can be analysed and presented in a variety of ways (*e.g.* timed, frequency, and percentage data). Consequently, when the skills or areas of the game are combined to provide an analysis of team performance, different scales and frequencies prevent simple comparisons from being made. **S**cientific research investigating performance in rugby union has generally been limited to studies exploring teams´ patterns of play or physiological estimates of positional work rates of individual players (Bracewell, 2003; Jones *et al.*, 2004a; Duthie *et al.*, 2005; Deutsch *et al.*, 2007; Mouchet *et al.*, 2008; Neville *et al.*, 2008).

The greater professionalism of rugby union has increased scientific research in the sport; however, there is scope for significant refinement on match-analysis and sports-specific testing procedures. A small number of studies have attempted to provide indicators of team performance through the comparison of winning and losing teams (Hughes & White, 1997; Stanhope & Hughes, 1997; Hunter & O'Donoghue, 2001; McCorry *et al.*, 2001; Bracewell, 2003; Jones *et al.*, 2004a; Van Rooyen, *et al.*, 2005; Csataljay, *et al.*; 2009; Ortega *et al.*, 2009; Vaz *et al.*, 2010). Hughes & White (1997) for example, investigated differences between forwards´ patterns of play of successful and unsuccessful teams during thirty-two games from the 1991 rugby union World Cup. The findings suggested that the forwards of successful teams were more dominant in the lineout through the use of more throwing options, and in the driving areas of the game (rucking and mauling), as well as being technically superior at scrummaging.

Stanhope & Hughes (1997) also examined team performances from the 1991 World Cup tournament with regard to the tactical significance of the different methods of scoring points to successful teams. Although similar patterns of play were observed between successful and unsuccessful nations, those teams that were successful were found to be better at rucking and in their kicking performance. A more effective rucking and kicking game was also demonstrated to result in more penalties being gained by the successful teams and the subsequent exploitation of the unsuccessful teams' poor defending in danger areas of the pitch.

Bracewell (2003) has quantified the performance of individual Rugby players using multivariate analysis and modified control chart methodology. The results showed that individual rugby player performance could be explained by contextual ratings using the multivariate control methodology.

Another study has contrasted specifically winning and losing teams in rugby union games (Jones *et al.*, 2004a), using twenty league matches from the domestic season of a professional male rugby union team. A comprehensive list of twenty-two team performance indicators were developed via expert coaches and analysts. Results of each indicator revealed statistical differences between winning and losing performances for only two of the identified team indicators (lineouts won on opponent team`s throw and tries scored).

The concept of close games have been looked at before by Csataljay *et al.* (2009). In recent research has attempted to determine the performance indicators that distinguish between winning and losing performances in matches between closely ranked teams.
More recently, Ortega *et al.* (2009) and Vaz *et al.* (2010), contrasted differences in game statistics between winning and losing rugby teams using a large sample of high-level games (Six Nations and Super Twelve), and they controlled the differences in final game score.

The Ortega *et al.* (2009) results, showed that winning teams: a) in the phases of obtaining the ball and more specifically in scrummage and line-out, lose fewer balls than losing teams (have more efficacy); b) tends to play more with their feet when they obtain the ball, to utilize the maul as a way of attacking, and to break the defensive line

more often than the losing team does; and c) on defense, recovered more balls and completed more tackles than losing teams, (percentage of tackles completed was 94%).
Vaz *et al.* (2010) concluded that international competitions that include teams from all nations are unlikely to show statistically significant differences between winning and losing teams when the final score is 15 points or less. These differences either do not exist at this level of significance or these differences are being obscured by differences in playing style, especially when matches are played by a team comprising players from the northem and southem hemispheres. S12 competition do elicit significant differences between winning and losing teams and suggest that a kicking based game plan is a more effective style of play than an open running possession dominated game.

The current research and several previous studies (Holmayard & Hazeldine, 1993; Villepreux, 1996; Hughes & White, 1997; Devaluez, 2000; Mouchet *et al.*, 2008) have suggested that certain factors contribute to successful rugby performances. For example Mouchet *et al.* (2008) made a comparative study between nations attempting to characterize the efficiency factors which ensure the continuity of game movement. The results suggest a relative variety of pragmatic models, which show the existence of common tendencies and particular styles. These models contribute also to scientific debates on decision-making in sport. Indeed, they advance through the link between strategic and tactical decisions.

In rugby, the recent changes in the rules (2008) have made the play "more open", faster and more attractive to spectators. The ball is quickly recycled and play continued.
Few studies have detailed the movements of players during rugby either under the new or traditional rules and there is a need for further analysis on the current game at the elite level.

The impact statistics have in a rugby environment is readily identifiable in some scientific publications. The problems associated with univariate statistics due to match volatility highlighted the need for 'stable' data, which is provided in the form of the overall performance measure obtained via multivariate techniques. Furthermore the time spent exploring a database is minimized by pinpointing the possible areas of anomalous behavior. Objective match statistics provide an unbiased record of the game, albeit from a limited scope due to an information/resource trade-off.

However, assessing the physical tasks performed by an individual provides an indication of his performance (Bracewell, 2003). A rating that summarises on-field performance reduces significantly the amount of data that interested parties need to review. In fact, the definition of performance has important implications as to how the latent dimensionality of match data is interpreted. For example, individual ability cannot be gauged from one match as the expressed performance is vulnerable to relative involvement.

Consequently strings of matches must be considered, as described later. Further, in order for a physical task to be completed successfully, the associated physiological and mental skills must also have been completed successfully, justifying the sole use of physical task measures to quantify performance.

Comparing winning and losing sides may therefore result in a potential loss of any meaningful information due to each team possessing different styles of play and consequently, diverse performance profiles.

The aim of this study therefore was to develop a methodology to discriminate team performance indicators by analysing a large sample of rugby matches from elite level. We apply a measure to control for the differences in match scores and to determine if there are any game-related statistics that can discriminate between winning and losing teams in close and balanced games.

Further research in these areas, coupled with more comprehensive studies of the movement patterns of contemporary rugby, will contribute to the development of more effective knowledge of the demands of the game.

2. Methods

2.1. Sample and Variables

Archival data were gathered from International Rugby Board (IRB) competitions (n=110 games, World Cup and 6 Nations) and (n=174, Tournament S12 played between 2003 and 2006. Data was collected by using a digital video analysis system (*Rugby Stats Fair Play Sports Analysis Systems V_2, Australia)* and *Rugby Match Analysis and Statistics (IRB - Computacenter/S.A.S, 2003)*. The game-related statistics that determine game outcome are dependent upon final score differences. For the amount of data generated be useful to study, match statistics need to be summarised. Dimension reduction techniques are suitable for creating meaningful summaries of the data, provided a lower intrinsic dimensionality exists. The data needed to be cleaned prior to commencing dimension reduction.

Primarily, this involved identifying heterogeneous games groups' clusters. Expert opinion was used to define positional clusters that needed to be identified due to the different demands placed on each of the different groups of games. Cluster analyses provides convincing results from the database and were conducted to establish three different groups of games according to final score differences (see Table 1).

The cluster analysis was performed separately to IRB and S12 data in order to preserve the competition style of play.

Results allowed assigning a range of points differences to the various groups, close, balanced and unbalanced games for both the IRB and S12 data. The close games clusters for final analysis, in the IRB group gathered 64 games with final score differences under 15 points and the S12 group gathered 95 games with final score differences under 11 points. In balanced games clusters were selected for final analysis, the IRB group gathered 46 games with final score differences under 34 points and the S12 group gathered 79 games with final score differences under 25 points

Table 1. Results from cluster analysis according to game final score differences (close, balanced and unbalanced games).

Group	Cluster group	Score differences	Games (%)
IRB	Close Games	0 a 15 points	64 (53%)
	Balanced Games	16 a 34 points	46 (38%)
	Unbalanced Games	35 a 53 points	10 (8%)
S12	Close Games	0 a 11 points	95 (46%)
	Balanced Games	12 a 25 points	79 (39%)
	Unbalanced Games	26 a 43 points	30 (15%)

The variables gathered by the specialised data centres were the following: Scrums won and lost, Lineouts won and lost, Penalty conceded, Free kicks awarded, Ruck and drive, Ruck and pass, Mauls won and lost, Turnovers won on opposition possession, Passes completed, Possession kicked (not including penalties or free kicks that were kicked to touch), Errors from kicks, Kicks to touch, Tackles made and missed, Error made, Tries, Conversions, Penalty goals and Drop goals awarded. A random sample of 10 games was used to test inter-rater reliability (kappa coefficients) using two experienced analysts. The results had agreement coefficients of at least 0.91.

2.2. Data Analysis

The cluster analysis was performed separately to IRB and S12 data. Results allowed assigning a range of points differences to the various groups in IRB and S12 data.

All data gathered were converted to z-scores and the differences between winners and losers were tested by repeated measures ANOVA. Following this procedure, discriminant analysis was performed in order to determine: i) which of the obtained variables are more useful in predicting game final outcome in close and balanced games either for IRB or S12 matches; ii) the mathematical equation that enhanced differences in variable means between winning and losing teams, and, iii) the accuracy of the equations.

Assumptions on discriminant analysis were for independency amongst variables, multivariate normal distribution and equal variance-covariance across groups (Silva & Stam, 1995). In our study discriminant analysis is considered to be robust with these variables (Norušis, 1998).

The interpretation of the obtained discriminant function was based on examination of the structure coefficients greater than |0.30|, meaning that variables with higher absolute values had a powerful contribution to discriminate between groups (Tabachnick & Fidell, 2007).

In order to facilitate understanding, the data is presented as means ± standard deviations and the statistical significance for all tests was set at 95%. The statistical analyses were performed using SPSS software release 17.0.

3. Results

Results from repeated measures ANOVA did not identify any statistically significant differences between winners and losers in close games from the IRB group (see Table 2). For the S12 group, several differences were identified (see Table 3). The winning teams made fewer rucks, fewer mauls and turnovers won, completed fewer passes and made fewer errors ($p<0.05$). They also kicked a greater amount of their possession (including kicks to touch) and made more tackles ($p<0.01$).

For balanced games results from repeated measures ANOVA identify statistically significant differences between winners and losers in the games from the IRB group (see Table 2) and S12 group (see Table 3). In IRB group the winning teams won more lineouts and they lost less in relation to losers teams.

In relation to the defensive aspect of the game, several differences were identified in tackles missed for winners (19.2±12.7) and (29.6±17.9) for losers ($p<0.01$).

Table 2. Game performance parameters in close games (n=64) and balanced games (n=46) from the IRB group (results are mean ± standard deviation).

Game–related statistics	Close games		Balanced games		
	Winners	Losers	Winners	Losers	
Scrums won	10.7±4.2	10.0±4.2	11.7±4.7	10.6±4.1	
Scrums lost	1.0±1.6	0.8±1.3	1.3±1.8	1.0±1.3	
Lineouts won	16.3±4.5	16.1±4.9	17.4±4.8	15.3±4.6	*
Lineouts lost	2.3±2.0	2.8±2.2	2.0±1.6	3.3±2.3	**
Penalty conceded	10.5±3.3	11.1±2.9	10.8±3.6	10.9±3.7	
Free kicks	1.0±1.2	1.0±1.0	1.4±1.5	1.5±1.2	
Rucks and drive	22.0±17.3	19.8±10.5	23.4±12.9	23.2±10.8	
Rucks and pass	29.5±15.3	30.2±14.2	31.9±15.9	29.7±15.4	
Mauls won	24.1±16.3	23.8±19.3	22.8±13.0	22.9±16.0	
Mauls lost	4.9±3.6	4.9±3.6	4.7±4.0	5.6±4.0	
Turnovers won	12.1±9.2	12.4±9.1	15.1±10.0	14.3±11.3	
Passes completed	105.3±36.5	106.2±37.6	118.1±44.1	106.0±39.7	
Possession kicked	23.0±9.4	20.9±8.9	22.2±8.8	20.2±7.3	
Errors from kicks	5.3±3.2	4.9±3.1	5.0±2.9	4.7±2.4	
Kicks to touch	10.6±4.7	10.5±4.6	10.4±5.0	9.9±3.5	
Tackles made	88.0±27.6	89.8±37.8	89.0±27.4	96.7±24.7	
Tackles missed	18.4±13.8	20.7±14.7	19.2±12.7	29.6±17.9	**
Errors made	12.5±7.9	12.4±7.9	14.6±7.9	13.8±8.9	

*$p<0.05$; ** $p<0.01$.

In balanced games and for S12 group, several differences were identified (see Table 3). The winning teams made fewer errors, lineouts lost, mauls won, turnovers won and tackles missed ($p<0.05$). The losers teams made fewer penalty conceded, possession kicked (including kicks to touch) and tackles made ($p<0.05$).

Table 3. Game performance parameters in close games (n=95) and balanced games (n=79) from the S12 group (results are mean ± standard deviation).

	Close games			Balanced games		
Game–related statistics	Winners	Losers		Winners	Losers	
Scrums won	11.4±4.3	10.4±3.4		10.2±3.5	9.7±3.4	
Scrums lost	0.6±0.8	0.7±1.0		0.6±0.7	0.5±0.6	
Lineouts won	16.5±5.4	16.2±5.1		16.0±4.1	16.7±4.3	
Lineouts lost	2.9±1.8	3.4±3.2		2.3±1.5	3.5±2.3	**
Penalty conceded	9.7±3.2	9.7±2.8		10.8±3.7	9.3±2.6	**
Free kicks	0.9±1.0	0.8±1.2		0.8±1.1	0.7±0.8	
Rucks and drive	21.6±13.1	24.6±14.7		25.0±13.8	23.5±13.8	
Rucks and pass	22.3±10.3	26.4±11.0	*	23.8±9.2	25.8±10.2	
Mauls won	37.4±13.9	42.6±16.5	*	39.8±12.8	46.5±16.9	**
Mauls lost	7.5±7.4	7.9±6.7		7.3±5.4	7.3±4.8	
Turnovers won	22.4±4.9	24.0±5.7	*	21.5±5.0	24.7±4.9	**
Passes completed	80.8±23.2	89.9±25.3	*	83.9±18.8	86.9±24.2	
Possession kicked	15.7±4.9	13.6±4.3	**	15.4±4.9	11.9±4.3	**
Errors from kicks	5.8±3.1	6.5±3.3		5.3±2.8	5.4±3.0	
Kicks to touch	11.6±4.2	10.4±3.9	*	11.6±4.5	9.3±4.6	**
Tackles made	112.7±33.1	99.4±30.0	**	116.2±30.1	107.0±24.7	*
Tackles missed	36.6±16.4	33.8±13.3		33.0±11.8	39.2±12.0	**
Errors made	11.7±4.3	13.0±4.4	*	11.4±4.0	12.5±4.1	*

*p<0.05; ** p<0.01.

In close games the discriminant function structure coefficients (SC) and test of statistical significance for game performance parameters was statistically significant for S12 (Chi-squared = 33.8, p<0.05), but not for IRB games (Chi-squared = 9.4, p= n.s.). The winners and losers in the S12 group (see Table 4), were discriminated by possessions kicked (SC=0.48), tackles made (SC=0.45), rucks and pass (SC=-0.40), passes completed (SC=0.39), mauls won (SC=-0.36), turnovers won (SC=-0.33), kicks to touch (SC=0.32) and errors made (SC=-0.32). The final reclassification from the analysis was high 78%.

In balanced games (SC) results showed that, was statistically significant for IRB (Chi-squared = 39.1, p<0.05), and for S12 (Chi-squared = 68.4, p<0.05).

The winners and losers in the IRB group (see Table 4), were discriminated by tackles missed (SC=-0.43), and lineouts lost (SC=-0.42).

The winners and losers in the S12 group (see Table 4), were discriminated by possessions kicked (SC=0.49), turnovers won (SC=-0.41), lineouts lost (SC=-0.38), tackles missed (SC=-0.34), and kicks to touch (SC=0.32). The final reclassification from the analysis was high 73%.

Table 4. Discriminant function structure coefficients (SC) and test of statistical significance for performance parameters in IRB and S12 groups.

	Close games		Balanced games	
Game - related statistics	IRB group	S12 group	IRB group	S12 group
Tackles missed		0.20	-0.43*	-0.34*
Lineouts lost		-0.22	-0.42*	-0.38*
Lineouts won		0.06	0.28	-0.11
Tackles made		0.45*	-0.19	0.21
Passes completed		0.39*	0.19	-0.09
Scrums won		0.27	0.16	0.09
Possessions kicked		0.48*	0.15	0.49*
Mauls lost		-0.05	-0.14	-0.00
Scrums lost		-0.05	0.12	0.07
Rucks and pass		-0.40*	0.09	-0.13
Kicks to touch		0.32*	0.07	0.32*
Error made		-0.32*	0.06	-0.17
Errors from kicks		-0.21	0.06	-0.02
Turnovers won		0.33*	0.05	-0.41*
Free kicks		0.05	-0.03	0.05
Rucks and drive		-0.22	0.01	0.07
Penalty conceded		0.01	-0.01	0.29
Mauls won		-0.36*	0.00	-0.29
Canonical correlation		0.42	0.61	0.61
Chi-squared		33.8	39.1	68.4
Wilks Lambda		0.81	0.62	0.62
p		≤0.05	≤0.05	≤0.05

* SC Discriminant value $\geq$ 0.30

4. Discussion

The first objective of the study was, to identify if there were any rugby game-related statistics that could discriminate between winning and losing teams in IRB and S12 close and balanced games.

Furthermore, we have presented an explicit process for identifying key performance indicators, together with suitable discriminated descriptions of these indicators. The results showed that when compared, IRB and S12 close and balanced games were evident, although significant between-games differences were found for all of the analysed group clusters. This suggests that for close and balanced games a general profile may be created, which is probably specific to each team, and may indicate the strengths and weaknesses of that specific competition groups.

For close games there were very few descriptors that showed a consistent trend between the IRB group and the S12 group. However, the data showed that winning international matches during 2003 and 2006 consistently kicked away possession and were more effective at retaining the ball on their own lineout than losing teams.

It was also interesting to note that winning teams also made fewer passes and won fewer turnovers on their opposition's possession. This later finding contrast with the work of Jones et al. (2004a) who found that winning teams won more possession from their opposition at the breakdown situation. Explanations on this contrast may be related to sample size and type as Jones et al. (2004a) analyzed twenty league matches from the domestic season of a professional male Rugby union team.

In close games the S12 group did elicit several discriminatory variables (see Table 4) that could distinguish between a winning and a losing team's game profile. This study found that kicking the ball away and making more tackles than the opposition were the two most influential factors in determining winning from losing teams. Although speculative, this therefore tends to suggest that the winning S12 teams are able to effectively kick possession away and defend the territorial gains that they have won through their ability to make more tackles. It is interesting to note that the losing teams lost more of their lineouts than the winning teams, indicating that winning teams can successfully steal the ball from the opposition's lineout and convert the resulting possession to points.

Globally, there were significant differences found in close and balanced IRB and S12 matches, even though these matches were separated by a final score differences. For balanced games the data showed that winning teams won more lineouts and they lost less than losers' teams. In fact this result suggests the lineout is an important influential factor in determining winning from losing teams. It was also interesting to note that winning teams also made fewer tackles missed. In defensive aspect of the game, the tackles made and missed have important significance in rugby union game.

The general significant differences between winning and losing teams for the analysed games suggest the existence of different movement patterns, styles of play and performance profiles in rugby teams. In balanced games for S12 group, winning teams made fewer errors; lineouts lost, mauls won, turnovers and tackles missed. The losers teams made fewer penalty's conceded, possession kicked (including kicks to touch) and tackles made.

This idea is supported because the IRB data consisted of a combination of Northern and Southern hemisphere teams and S12 data have only Southern hemisphere teams.
Previous work has shown differences between the playing styles of northern and southern hemisphere teams (Villepreux, 1996; Devaluez, 2000; Jones *et al*., 2004b; Mouchet *et al.*, 2008).

Our results are similar from those found by Jones *et al.* (2004a) and Ortega *et al.* (2009), which found positive results for scrums won, line-outs and turnovers won in favour of the winners. In general, winning teams have more tackles made and less

tackles missed than losers. These results seem to indicate that on defence winners are more efficient than losing and can negatively influenced the final result of the game.

In balanced games the results, showed that in groups the structure coefficients (SC) obtained through a discriminant analysis allowed to identify in IRB the tackles missed (SC= -0.43), and lineouts lost (SC = -0.42) and in S12, tackles missed (SC=-0.34) and lineouts lost (SC= - 0.38) are powerful game-related statistics in discriminating between winning and losing teams.

This study found that make more tackles missed and more lineouts lost were the two most influential factors in determining winning from losing teams in groups´. Although speculative, this therefore tends to suggest that the winning teams are able to effectively in lineouts and defend the territorial gains because they have won through their ability to make more tackles. It is interesting to note that the losing teams lost more of their lineouts than the winning teams, indicating that winning teams can successfully steal the ball from the opposition's lineout and convert the resulting possession to points. The location on the field where the lineout was lost might be of more significance than just the frequency of how many lineouts were lost. For example a lineout that was lost deep inside the defensive 22 is more likely to result in points being conceded than lineout ball that was lost in the midfield area, but this suggestion requires further research.

The winners and losers in the S12 group were discriminated by possessions kicked, turnovers won, lineouts lost, tackles missed, and kicks to touch. It can be explained by different playing patterns, especially as this study shows the differences between the playing styles of northern and southern hemisphere teams.

In addition, the differences observed within the behaviors as a function of winning and losing provide an indication of where to direct such technical support to the team in order to maximize performance. For example, the large differences observed in the turnovers won and the success at lineouts suggest that emphasis should be placed on the coaching of these specific areas in future training sessions for the teams.

5. Conclusion

The data demonstrate the highly intermittent and varied nature of play in the IRB and S12 rugby close and balanced games. The observed differences between groups and playing levels in this investigation imply that players must be specifically prepared for the demands of rugby match-play.

Detailed information of differences between groups provides comprehensive assessment of the demands of competition and assists in developing specific training process. Descriptive analysis of the occurrence of these activities during competition will assist coaches and conditioning staff in the prescription of training for forwards and backs. Furthermore, quantifying movement patterns over an entire game may provide insight into any fatigue related changes in performance between the first and second half. Collectively these findings provide important information for the prescription of training and testing aimed at developing physiological qualities specific to the demands

of competitive elite rugby. Differences were found between groups of close and balanced games, especially between winning and losing teams in S12 with regards to different playing patterns and play style of south hemisphere.

In summary, this study shows that elite level competitions that include rugby teams from all nations are unlikely to show statistically significant differences between winning and losing teams when the difference between the final score is considered. These differences either do not exist at this level of significance or these differences are being obscured by differences in playing style, especially when matches are played by a northern and southern hemisphere team, however further research is required to confirm this suggestion.

6. Acknowledgements

The authors wish to acknowledge to Professors Jaime Sampaio and Antonio Serôdio from University of Trás-os-Montes and Alto Douro, for supervision and collaboration in this study.

7. References

Bracewell, P. (2003). Monitoring meaningful Rugby ratings. **Journal of Sports Sciences**, 21, 611-620.

Csataljay G, O´Donoghue P, Hughes M, Dancs H. (2009). Performance indicators that distinguish winning and losing teams in basketball. **International Journal of Performance Analysis in Sport**, 9, 60-66.

Deutsch, M., Kearney, G., & Rehrer, N. J. (2007). Time – motion analysis of professional Rugby union players during match-play. **Journal of Sports Sciences**, 25, 461-472.

Devaluez, J. (2000). **Pour un nouveau rugby**. Éditions Chiron, Paris.

Duthie, G., Pyne, D. & Hooper, S. (2005). Time motion analysis of 2001 and 2002 Super 12 Rugby. **Journal of Sports Sciences**, 23, 523-530.

Holmayard, D. & Hazeldine, R. (1993). Seasonal variations in the antropometric and physiological characteristics of international rugby union players. **Science and Football II**, Reilly, T & Clarys (eds.). E & FN Spon, London, 21-26.

Hughes, M. & White, P. (1997). An analysis of forward play in the 1991 Rugby union world cup for men. **Notational Analysis of Sport I & II**, Hughes, M. (ed.), Cardiff, University of Wales. 183 -191.

Hunter, P. & O'Donoghue, P. (2001). A match analysis of the 1999 Rugby Union World Cup. In **Pass.com: Fifth World Congress of Performance Analysis of Sport**, Hughes, M. and Franks, I.M. (eds.), Cardiff: University of Wales Institute, 85-90.

Jones, N., Mellalieu, S. & James, N. (2004a). Team performance indicators as a function of winning and losing in Rugby union. **International Journal of Performance Analysis in Sport**, 4, 61-71.

Jones, N., Mellalieu, S., James, N. & Moise, J. (2004b). Contact area playing styles of northern and southern hemisphere international Rugby union teams. In

Performance Analysis of Sport VI. O'Donoghue, P.G. & Hughes, M. (eds.). pp.114-119.

Neville A, Atkinson G, Hughes M (2008). Twenty-five years of sport performance research in the Journal of Sport Sciences. **Journal of Sport Sciences**, 26, 413-426.

Norušis, M. (1998). SPSS 8.0: **Guide to Data Analysis**. Upper Saddle River: Prentice-Hall.

McCorry, M., Saunders, E.D., O'Donoghue, P.G. & Murphy, M.H. (2001). A match analysis of the knockout stages of the 1995 Rugby Union World Cup. In **Notational Analysis of Sport III**, Hughes, M. (ed.), Cardiff: University of Wales Institute, Cardiff. 230-239.

Mouchet, A., Uhlrich, G., & Bouthier, D. (2008). Dynamique de production du jeu de mouvement en rugby : tendances communes et particularités au niveau international, **Sciences et Motricité**, 64, 93-102.

Ortega, E.; Villarejo, D. & Palao, J. (2009).Differences in game statistics between winning and losing rugby teams in the Six Nations Tournament. **Journal of Sports Science and Medicine**. 8, 523-527.

Stanhope, J. & Hughes, M.D. (1997). An analysis of scoring in the 1991 rugby union World Cup. In **Notational Analysis of Sport III**, Hughes, M. (ed.), Cardiff: University of Wales Institute Cardiff. 167-176.

Silva, A., & Stam, A. (1995). Discriminant analysis. In L. Grimm & P. Yarnold (Eds.), **Reading and understanding multivariate statistics**, Washington: American Psychological Association. 277-318.

Tabachnick, B. & Fidell, L. (2007). **Using Multivariate Statistics**. 5ª ed. Boston: Allyn and Bacon.

Van Rooyen, M., Lambert, I. & Noakes, D. (2005). A Retrospective analysis of the IRB statistics and video analysis of match play to explain the performance of four teams in the 2003 Rugby World Cup. **International Journal of Performance Analysis in Sport**, 5, 57-72.

Vaz, L.,Van Rooyen, M. & Sampaio. J. (2010). Rugby game-related statistics that discriminate between winning and losing teams in IRB and Super twelve close games. **Journal of Sports Science and Medicine**. 9, 51-55.

Villepreux, P. (1996). **Formation au rugby de mouvement**. Edit. Stadium. Madrid

Address for correspondence:

Luís Vaz
Faculty of Sports Sciences
University of Trás-os-Montes e Alto Douro at Vila Real
Quinta de Prados, Ap. 202
5000-511 Vila Real, Portugal
E-mail: lvaz@utad.pt