Original Article

Situational coupling at the ruck and its effects on phase momentum and success in international men's and women's rugby sevens

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ABSTRACT

One of the most frequent contests for possession associated with rugby sevens is the ruck. There has been no research on the patterns of rucks in rugby sevens. The aim of this study was to examine the link between coupling at the ruck, phase momentum and success. Footage from all men's (N=63) and women's (N=35) IRB Sevens World Series Cup knockout matches played during 2014 were analysed. Situational coupling at the ruck was divided into four categories based on the location of players. These were wide rucks (4&0); mid to wide rucks (3&1); mid rucks (2&2) and foiled rucks for all other situations. Comparisons between winning and losing teams were examined. Winning women's teams crossed the advantage line resulting in positive momentum significantly more than losing teams (W 64.37% v L 49.59%). Situational analysis identified that wide rucks were most commonly used. Winning women created significantly more positive momentum from wide rucks (W 59.49% v L 42.36%) and scored more tries from wide rucks (W 0.91 v L 0.26) and mid rucks (W 0.53 v L 0.2). Winning men showed that attacking from mid rucks led to positive phases (W 79.17% v L 54.6%). Winners also scored significantly more tries from wide rucks (W 0.69 v L 0.39). Positive phase momentum is associated with three or more passes in men's rugby sevens and four or more passes in women's rugby sevens. Phase momentum has been shown to be an important aspect of success in rugby sevens. Situational analysis has identified that wide rucks are most commonly used and winning women use wide rucks whilst winning men use mid rucks to gain positive phase momentum. This study may assist coaches in developing strategies for creating positive phases in rugby sevens. **Key words:** PERFORMANCE ANALYSIS, RUGBY UNION, RUCKS, MOMENTUM

Cite this article as:
Barkell, J.F., O'Connor, D. & Cotton, W.G. (2017). Situational coupling at the ruck and its effects on phase momentum and success in international men's and women's rugby sevens. *Journal of Human Sport and Exercise, 12*(2), 294-306. doi:10.14198/jhse.2017.122.06

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Submitted for publication January 2017
Accepted for publication June 2017
JOURNAL OF HUMAN SPORT & EXERCISE ISSN 1988-5202

doi:10.14198/jhse.2017.122.06

INTRODUCTION

One of the most frequent contact situations associated with rugby sevens is the ruck (Barkell, O'Connor, & Cotton, 2016). Each ruck in rugby sevens is a contest for the ball and whilst the players involved in the ruck compete by pushing against their opponents, the remaining players on both teams spread out in a structured formation. The attacking team will set up in formation whilst the defensive team reacts and aims to form a defensive line to stop the next wave of attacking play. The formation a team takes has been referred to as coupling (McGarry, Anderson, Wallace, Hughes, & Franks, 2002). Coupling is the grouping or formation of players on a field around a certain location. Coupling in rugby sevens is dependent on the possible combinations of player formations at each location. Further to this, oscillation refers to the way the team's formation or coupling, fluctuates depending on the field location. For example the changing formation from a midfield location to a wide location on the field (McGarry et al., 2002).

Understanding player coupling and the oscillation of a team in certain positions could identify trends of play and predict team behaviour (McGarry et al., 2002). For example, the coupling of a rugby sevens team from a ruck at different places on the field may dictate the likelihood of the direction of attack. Therefore identifying trends within the coupling of certain positions and the oscillation of players may assist in predicting team behaviour and the likelihood of positive momentum (McGarry et al., 2002). Whilst the coupling of players is flexible and varying, it is common in rugby sevens for coupling to follow a pattern depending on where a team is situated on the field. Rugby sevens has limited variations of situational coupling at the ruck (Blackburn, 2014). During a ruck in rugby sevens, the attacking team generally consist of a ball carrier who is tackled, one support player who rucks for the ball and one player who acts as the half back to remove the ball from the ruck. This generally leaves four players to attack unless a competitive ruck requires more assistance or a player is injured. The coupling of the remaining four players is limited to four available variations (Blackburn, 2014).

Situation 1 commonly occurs wide on the field and due to the space available all four players move to the side of the ruck with the most space available. This leaves four players on one side of the ruck and none on the other side. This potentially reduces attacking options on both sides of the ruck.

Situation 2 commonly occurs in-between the middle of the field and the extremities of the field. In this situation three players usually line up on the side with the most attacking space available whilst one player creates an option on the other side of the ruck. This gives the attacking team potential attacking opportunities on both sides of the ruck.

Situation 3 commonly occurs in the middle of the field. Due to the positioning, equal space is available on both sides of the ruck and in this instance two players will usually position themselves on the left and two on the right giving each side an equal attacking opportunity.

Situation 4 only occurs when there is a variation to the four attacking players. This may be due to an injury, a player receiving a yellow card and thus being suspended for 2 minutes of the game or additional numbers in the ruck. This situation is uncommon and unconventional amongst the three other common coupling formations.

These situations of intra-player coupling are not exclusive, however are commonly formed attacking shapes used in rugby sevens. There is little evidence to suggest which shape is most widely used or most successful in terms of developing positive phases and scoring. Some shapes may also be associated with predictive

attacking options (Lemmink & Frencken, 2013; McGarry, 2006; McGarry et al., 2002; McGarry, Khan, & Franks, 1999).

Momentum in sport refers to the *intensity of movement* (Adler, 1978, p. 154). It can be classified in two ways, the successful repeatability of individual actions or the forward propulsion of a team toward a goal line (Adler, 1978; Hughes, Bürger, Hughes, Murray, & James, 2013; Hughes, Fenwick, & Murray, 2006; Mack & Stephens, 2000; Reed & Hughes, 2006). Momentum is believed to affect the flow of the game. Positive momentum is synonymous with confidence and determination, whilst negative momentum is identified with hesitation and indecision (Adler, 1978). Due to these beliefs, coaching publications advocate positive momentum as an essential aspect of sports coaching (Higham, 2000; Higham, Harwood, & Cale, 2005).

Whilst it is often believed that positive phase momentum will lead to successful performance, empirical studies on the effects of momentum are both limited and inconclusive. Due to the complex nature of rugby union where the ball can only be passed backward, progress up the field is dependent on cycles of passing backwards and moving forwards with the ball. These cycles are commonly referred to as phases. Producing a number of positive phases has been tested in 15-a-side rugby union with the outcomes suggesting that forward momentum could provide a framework for successful performance (Reed & Hughes, 2006).

Studies have identified that, like 15-a-side rugby union, rugby sevens also requires possession to be successful (Higham, Hopkins, Pyne, & Anson, 2014a, 2014b). Apart from the previous work of Reed and Hughes (2006), there is limited evidence of the effects of positive phase momentum in 15-a-side rugby union, whilst the effects of positive phases in rugby sevens is yet to be studied. Due to the nature of the game, where teams pass backward to go forwards, phase momentum should be analysed alongside the behavioural dynamics of team play.

The aim of this study is to identify any predictive patterns of player coupling associated with ruck location. Once this is established it is intended to examine if positive phases are specific to certain attacking shapes and if the situational coupling at the ruck can help us predict specific attacking movements.

MATERIAL AND METHODS

Sample

Game footage from all men's (N=63) and women's (N=35) World Rugby Sevens Series Cup knockout fixtures played during the 2014 calendar year were analysed. Pool fixtures were excluded due to potentially skewed data resulting from one sided results between top tier and bottom tier teams. From this sample all men's (N=969) and women's rucks (N=601) were analysed independently of gender.

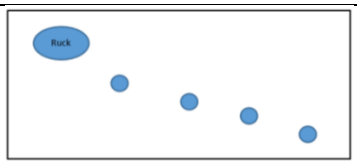
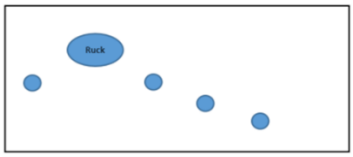
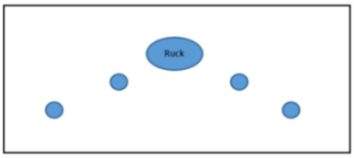
Game variables

Attacking rucks were identified as rucks where the possession was subsequently used as opposed to a penalty or error occurring. Each attacking ruck was coded as the start of a phase. A phase in rugby sevens is defined the same way as 15-a-side rugby union, this being the time the ball is in possession until the ensuing breakdown in play or change of possession (i.e. ruck, kick, score) (Reed & Hughes, 2006). Within each phase the situational coupling of attacking players and the result of the phase were coded. The number of passes, handling errors, pick and go movements and tries were also recorded.

Situational coupling refers to the structure of the attacking players at each ruck. Due to the nature of rugby sevens and number of players on the field, four potential attacking formations of players commonly occur. In

most ruck situations one player is tackled, one player rucks for the ball and one player acts as the half back to remove the ball from the ruck. This leaves four remaining players to set up an attacking structure (McGarry et al., 2002). The structure is usually based but not limited to the location of the ruck on the field. Situational coupling of attacking players is coded according to the definitions in Table 1.

Table 1. Definitions of the possible situational coupling of attacking players at the ruck

Ruck Type	Definition	Image
4 & 0	All players on one side of the ruck. This usually occurs wide on the field.	
3 & 1	Three players on one side of the ruck and one on the other. This usually occurs mid to wide.	
2&2	Two players either side of the ruck. This usually occurs in the midfield.	
Foiled	The only alternative to the above options would be if a player is out of the play for some reason (i.e. injury/suspension) or if the contest for the ball at the ruck requires an additional rucking player to successfully win the ball.	

Phase momentum was calculated by comparing the position of the ball at the start of the phase with the position of the ball and the location of the gain line at the end of the phase. The gain line is an invisible line that runs perpendicular to the side lines and parallel to the goal lines (Figure). The gain line is formed by the hindmost part of the player on the defensive side of the ruck. Phase momentum was coded in three categories, positive, neutral and negative (Reed & Hughes, 2006, p. 116).

Positive phases were considered to be any phase where the ball was carried over the gain line. Neutral phases were considered to be any phase where the ball was carried to the gain line but not over it. Negative phases were considered to be any phase where the ball failed to reach the gain line.

The remaining variables (effective and ineffective passes; pick and go; tries scored) were coded according to definitions previously reported in the literature (Barkell et al., 2016, p. 638).

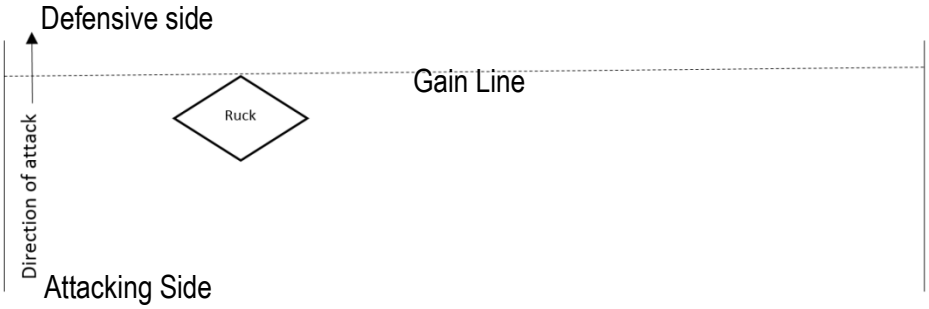


Figure 1. Diagram of gain line

Procedure

Publicly available footage of men's and women's World Rugby Sevens Series tournaments were recorded and formatted as MP4 digital video. Data was collected and coded via computerised notation whilst viewing the video on Microsoft Windows Media Player. Notational analysis has previously been recognised as a reliable technique for recording quantitative variables (Carling, Reilly, & Williams, 2008; Choi, 2014; Sampaio & Leite, 2013). Coding was performed on a spreadsheet designed using Microsoft Excel. A continuous scale was utilised to code the variables as they were performed. A separate line was used to code each phase with all variables that occurred within the phase being recorded on the same line.

System reliability

Both intra and inter-rater reliability testing were performed on 16% (N=16) of all games (N=98) coded to confirm an effective degree of reliability. Reliability testing was implemented by calculating the percentage error (Bishop & Barnes, 2013; Hughes, Cooper, & Nevill, 2004). For intra-rater reliability, percentage errors ranged from 0.00% (situational analysis of attacking players, pick and go, effective passes, ineffective passes and tries) to 0.29% (Neutral phases). Inter-rater reliability percentage errors ranged from 0.00% (pick and go and tries) to 3.89% (Neutral phases). The detected total errors were inside the 5% error limit as recommended by O'Donoghue and Holmes (2015). Further analysis was performed using Kappa tests, which identified a near perfect result for both intra and inter-rater reliability.

Data analysis

Data was transferred to Statistical Package for the Social Sciences (SPSS) version 22, following the completion of data entry into Microsoft Excel. Statistical analysis was used to calculate the means and standard deviations for the collected variables. Men's and women's data were analysed independently with the initial analysis comparing winners with losers.

Tests of normality were then performed on all data. The Kolmogorov-Smirnov test is suggested for sample sizes greater than 50, alternatively the Shapiro-Wilk test is preferred for sample sizes lower than 50 (O'Donoghue, 2012). Therefore the Kolmogorov-Smirnov test was utilised for the men's games (n=63) and the Shapiro-Wilk test for women' games (n=35). A p value greater than 0.05 or indicated normality.

The data included both normal and non-normal distributions. Game variables that were normally distributed examined differences between winners and losers using the Independent t-tests at the level of alpha of 0.05. Game variables that showed signs of non-normality, compared groups using the non-parametric Mann Whitney U Test at the level of alpha of 0.05. (O'Donoghue, 2010). Pearson's correlation coefficients (*r*) calculated the effect sizes and were presented as a small ($r = 0.1$), medium ($r = 0.3$), large ($r = 0.5$) or very large effect ($r > 0.7$) (Maher, Markey, & Ebert-May, 2013).

Further investigations of situational attacking structure analysis were performed using the chi square test of association (independence). These tests were utilised to identify if there were any associations evident between situational attacking structure and the related attacking options (number of passes, ineffective passes, pick and go and tries). For practical purposes the strength of the relationship was reported using Cramer's *V(φc)* (Field, 2009; Pallant, 2011). Values for Cramer's *V* were presented for df=1 as a weak association (*φc* < 0.1), moderate association (*φc* between 0.1-0.3) or strong association (*φc between* 0.3-0.5). For larger tables the value of *φc* decreases. With a df=2 (weak<0.07, moderate 0.07-0.21, strong 0.21-0.35), and with df=3 (Weak<0.06, moderate 0.06-0.17, strong 0.17-0.29) (Cohen, 2013).

RESULTS

Results identified that the total number of attacking rucks showed no significant differences between winning and losing teams. Winning women's teams had a significantly higher percentage of positive phases (*t*(67)=2.742, *p*<0.01, *r*=0.31). Losing men's and women's teams had a significantly higher percentage of neutral phases (Men: *U*=1495.0, *p*<0.05, *r*=0.20), (Women: *U*=413.5 *p*<0.05, *r*=0.21). Losing women's teams had a significantly higher percentage of negative phases (*U*=401.5, *p*<0.05, *r*=0.22). Table 2 illustrates the differences in phase momentum and situational ruck data between winning and losing teams. Game variables are displayed as frequency counts in bold or percentages (%) in italics.

A chi square test of association identified that positive phases are associated with three or more passes in men's rugby sevens (*χ*2 (4, *n*=969) =68.419, *p*<0.001, *φc*=0.266) and four or more passes in women's rugby sevens (*χ*2 (4, *n*=601) =58.848, *p*<0.001, *φc*=0.313). In men's rugby sevens performing no passes was associated with neutral (*χ*2 (4, *n*=969) =21.329, *p*<0.001, *φc*=0.148) and negative (*χ*2 (4, *n*=969) =22.715, *p*<0.001, *φc*=0.153) phases. In women's rugby sevens performing only one pass was associated with neutral phases (*χ*2 (4, *n*=601) =22.436, *p*<0.001, *φc*=0.193). In both men's and women's rugby sevens handling errors resulting from ineffective passes were associated with negative phases (Men: *χ*2 (1, *n*=969) =30.360, *p*< 0.001, *φc*=0.177), (Women: *χ*2 (1, *n*=601) =25.485, *p*<0.001, *φc* =0.206).

Situational coupling of attacking players identified that 4&0 rucks were most commonly used in both genders followed by 3&1 rucks, 2&2 rucks and finally foiled rucks used the least (Men: χ^2 (3, *n* =969) =229.832, *p*<0.01, *r*=0.49), (Women: χ^2 (3, *n*=601) =247.220, *p*<0.01, *r*=0.64).

Winning women created significantly more positive phases from 4&0 rucks than losing teams (*t*(68)=2.559, p<0.05, r=0.29). Both winning men's teams and women's teams scored significantly more tries from 4&0 rucks (Men: *U*=1224.5, *p*<0.05, *r*=21), (Women: *U*=325.5, *p*<0.01, *r*=0.44). Despite the above results, a chi square test of association identifies that winning women's teams made more passing errors from 4&0 rucks than from all other forms of rucks (*χ*2 (3, *n*=275) =10.027, *p*=0.018, *φc*=0.191).

4&0 coupling also had an association with higher numbers of passes. All men's teams showed a significant association with performing three or more passes from 4&0 coupling (*χ*2 (12, *n*=969) =90.665, *p*<0.001, *φc*=0.177) whereas winning men's and women's teams consistently performed four or more passes from 4&0 rucks (men: *χ*2 (12, *n*=468) =56.209, *p*<0.001, *φc*=0.200), (Women: *χ*2 (12, *n*=275) =45.910, *p*<0.001, *φc*=0.236). All teams were significantly less likely to perform pick and go movements from 4&0 rucks (Men: χ2 (3, *n*=969) =35.572, *p*<0.001, *φc*=0.192), (Women: χ2 (3, *n*=601) =10.454, *p*=0.015, *φc*=0.132).

Losing women's teams used 3&1 rucks (*U*= 415.5, *p*<0.05, *r*=0.31) significantly more than winning women's teams. A chi square test of association indicates that winning men's teams were significantly more likely to

throw no passes from 3&1 rucks compared to all other ruck types (χ2 (12, n=468) =56.209, p<0.001, φc=0.200). While all teams were unlikely to perform 4 or more passes from these rucks (χ2 (12, n=969) =90.665, p<0.001, φc=0.177). Winning men's teams performed pick and go movements significantly more regularly from 3&1 rucks (χ2 (3, n=468) =16.405, p=0.001, φc=0.187) compared with losing teams who performed pick and go movements significantly more at 2&2 rucks (χ2 (3, n=501) =25.908, p<0.001, φc=0.227).

Winning women's teams scored significantly more tries from 2&2 rucks (U=155.5, p<0.05, r=0.31). In comparison losing teams had a significantly higher percentage of negative phases from 2&2 rucks (U=166.0, p<0.05, r=0.22) and demonstrated significantly more errors from this position (χ2 (1, n=80) =6.086, p=0.014, φc=0.276). Winning men's teams had a significantly higher percentage of 2&2 rucks that resulted in positive phases than losing teams (U=517.5, p<0.01, r=0.30), and they were also associated with more positive phases than all other ruck types in both men's rugby sevens (χ2 (3, n=468) =9.411, p=0.024, φc=0.142). A chi square test of association identified that all men's and women's teams regularly passed only once from 2&2 rucks (Men: χ2 (12, n=969) =90.665, p<0.001, φc=0.177), (Women: χ2 (12, n=601) =50.350, p<0.001, φc=0.289).

Winning men's teams scored significantly more tries from foiled rucks than losing teams (U= 503.0, p<0.05, r=0.26). All men's teams were unlikely to pass 4 or more times from foiled rucks (χ2 (12, n=969) =90.665, p<0.001, φc=0.177), whilst winning teams were likely to pass just once (χ2 (12, n=468) =56.209, p<0.001, φc=0.200). Foiled rucks were also associated with negative phases in men's rugby sevens (χ2 (3, n=969) =13.924, p=0.003, φc=0.120). Losing women's teams performed significantly more pick and go movements from foiled rucks (χ2 (3, n=326) =9.811, p=0.020, φc=0.173).

DISCUSSION

The aim of this study was to identify any predictive patterns of player coupling associated with ruck location. It also aimed to examine if phase momentum and particular attacking movements were specific to certain attacking formations.

In team sports, momentum is often described as a variable responsible for success (Adler, 1978; Mack & Stephens, 2000; Reed & Hughes, 2006). The results of this study suggest that winning teams do develop more positive phases from rucks than losing teams, suggesting that positive phase momentum is a performance indicator in rugby sevens. This result corresponds with previous work identifying the positive effects of forward momentum in 15-a-side rugby union (Reed & Hughes, 2006).

Phase momentum creates a rolling effect of positive phases allowing support players to receive the ball from a forward moving direction and has previously been linked to higher running speeds when receiving the ball (Sayers & Washington-King, 2005) and the use of evasion before contact (Wheeler, Askew, & Sayers, 2010; Wheeler & Sayers, 2011) in 15-a-side rugby union. Likewise, running speed and evasive skills have also been identified as performance indicators in rugby sevens (Hughes & Jones, 2005; Ross, Gill, & Cronin, 2014; Suarez-Arrones et al., 2014). Considering that running speed and evasion are associated with positive phases, creating opportunities for players to reach peak velocities and utilise maximal space would be advantageous (Wheeler & Sayers, 2011). Situational coupling and attacking options that create space for players to use speed and evasion should therefore be utilised more regularly to enhance the chances of creating positive phases.

Table 2. Differences in phase momentum and situational ruck data between winning and losing teams in Cup knockout games in Men's and Women's World Rugby Sevens Series tournaments.

	Men's Cup Knockout Games						***Women's Cup Knockout Games***					
	Winners (N=63)		**Losers (N=63)**				**Winners (N=35)**		**Losers (N=35)**			
Variable	**Mean**	**SD**	**Mean**	**SD**	***r* ES**	***P* Value**	**Mean**	**SD**	**Mean**	**SD**	***r* ES**	***P* Value**
Total attacking Rucks	7.05	4.64	7.62	3.70	0.07	0.164	7.54	3.78	9.03	4.56	0.18	0.102
Positive phases	4.46	3.02	4.10	2.32	0.07	0.789	4.69	2.94	4.26	2.49	0.08	0.705
Positive phases (%)	65.27	23.70	56.84	22.09	0.18	0.054	64.37	24.74	49.59	19.70	0.31	0.008*
Neutral phases	1.24	1.29	1.81	1.52	0.20	0.027*	1.49	1.96	2.14	1.63	0.18	0.038*
Neutral phases (%)	16.11	15.25	22.79	17.63	0.20	0.043*	16.22	19.56	23.83	16.53	0.21	0.027*
Negative phases	1.35	1.45	1.71	1.46	0.12	0.116	1.37	1.14	2.63	1.94	0.37	0.004*
Negative phases (%)	18.62	19.31	20.37	15.85	0.05	0.372	19.41	16.88	26.61	15.70	0.22	0.020*
Total Rucks with 4 & 0 split	3.17	2.38	3.46	2.35	0.06	0.496	4.40	2.71	4.00	2.26	0.07	0.596
Percentage of rucks with 4 & 0 split (%)	43.07	25.59	44.08	23.40	0.02	0.784	57.70	23.43	46.55	19.96	0.25	0.051
4 & 0 split with positive phases (%)	57.22	27.98	46.79	28.42	0.18	0.053	59.49	29.23	42.36	26.70	0.29	0.013*
4 & 0 split with neutral phases (%)	17.82	20.09	24.67	28.18	0.14	0.332	13.98	22.08	23.49	25.25	0.20	0.075
4 & 0 split with negative phases (%)	16.74	19.73	25.08	25.19	0.18	0.097	22.17	24.43	25.89	26.14	0.07	0.540
4 & 0 split with tries	0.69	0.79	0.39	0.59	0.21	0.035*	0.91	0.78	0.26	0.50	0.44	0.000*
Percentage of tries from 4 & 0 split (%)	47.23	44.72	50.57	43.89	0.04	0.760	55.21	42.22	32.29	39.19	0.27	0.076
Total Rucks with 3 & 1 split	2.10	1.96	2.24	1.81	0.04	0.442	1.97	1.47	3.17	2.18	0.31	0.019*
Percentage of rucks with 3 & 1 split (%)	28.01	20.03	27.09	17.37	0.02	0.782	24.16	17.62	30.91	17.40	0.19	0.071
3 & 1 split with positive phases (%)	57.62	38.66	62.94	35.22	0.09	0.523	60.06	39.11	53.66	35.83	0.09	0.511
3 & 1 split with neutral phases (%)	22.33	34.21	19.62	28.22	0.04	0.953	22.12	29.57	18.54	21.15	0.07	0.975
3 & 1 split with negative phases (%)	17.85	28.84	16.04	26.84	0.03	0.819	16.67	31.73	23.58	28.49	0.11	0.098
3 & 1 split with tries	0.41	0.57	0.25	0.48	0.15	0.116	0.55	0.63	0.29	0.46	0.23	0.097
Percentage of tries from 3 & 1 split (%)	27.36	37.15	25.83	38.46	0.02	0.754	32.69	37.19	44.44	44.40	0.14	0.441
Total Rucks with 2 & 2 split	1.10	1.21	1.08	1.08	0.01	0.810	0.91	1.04	1.37	1.26	0.20	0.112
Percentage of rucks with 2 & 2 split (%)	14.70	17.99	14.32	13.02	0.01	0.615	9.91	11.38	14.75	13.70	0.19	0.118
2 & 2 split with positive phases (%)	79.17	34.30	54.60	42.78	0.30	0.009*	66.67	44.10	43.40	41.90	0.26	0.078
2 & 2 split with neutral phases (%)	13.89	31.31	26.07	37.71	0.17	0.063	13.16	32.67	28.00	41.03	0.20	0.158
2 & 2 split with negative phases (%)	6.02	13.00	11.79	26.25	0.14	0.660	12.28	31.84	27.60	34.64	0.22	0.044*
2 & 2 split with tries	0.42	0.50	0.24	0.48	0.18	0.069	0.53	0.51	0.20	0.50	0.31	0.017*
Percentage of tries from 2 & 2 split (%)	30.69	38.82	28.46	41.26	0.03	0.684	24.99	22.82	27.78	44.57	0.04	0.517
Total Rucks with foiled split	1.00	1.27	1.11	1.27	0.04	0.533	0.57	0.70	0.77	0.97	0.12	0.509
Percentage of rucks with foiled split (%)	14.37	18.84	14.29	15.45	0.01	0.605	7.47	9.68	7.43	10.10	0.01	0.985
Foiled split with positive phases (%)	62.02	42.80	47.19	44.90	0.17	0.183	53.13	49.90	37.04	45.22	0.17	0.322
Foiled split with neutral phases (%)	9.32	26.01	19.12	31.83	0.17	0.101	15.63	35.21	33.33	45.37	0.21	0.203
Foiled split with negative phases (%)	22.06	32.49	24.91	36.30	0.04	0.827	28.13	44.60	21.29	38.69	0.08	0.730
Foiled split with tries	0.35	0.54	0.11	0.31	0.26	0.022*	0.25	0.45	0.11	0.32	0.18	0.296
Percentage of tries from Foiled split (%)	28.25	41.03	16.67	36.51	0.15	0.183	10.55	19.02	8.33	18.00	0.06	0.739

Results indicated that the most commonly occurring pattern of player coupling were wide 4&0 rucks in both men's and women's rugby sevens. These were followed by mid to wide 3&1 rucks then midfield 2&2, and finally foiled formations. Rucks with wide 4&0 formations use three or more passes significantly more than all of the alternate formations. This finding suggests that attacking teams pass three or more times in order to move the ball from one side of the field to the other. The two players positioned furthest from the ruck are used to attack the defensive line, while the two players positioned closest to the ruck act as ball distributors. This tactic may be associated with higher running speeds (Wheeler et al., 2010) due to the depth and distance from the defensive line of the third and fourth players compared with the first two players in the formation. The third and fourth players in the formation are required to stand deeper than any other players due to the laws of rugby requiring passes to be thrown backwards. When the players at depth receive the ball they should have the time and space to reach maximal speed (Wheeler et al., 2010). Further analysis revealed that passing three or more times in men's rugby sevens and four or more times in women's rugby sevens was associated with positive phases. Alternatively low passing numbers were associated with neutral or negative phases. Likewise phases with four or more passes in both men's and women's rugby sevens increased the try scoring rate significantly. This finding is supported by Ross and colleagues (2016) who identified that teams who had a greater ratio of passes to rucks tended to score more points. This indicates that player coupling with wide 4&0 formations give the attacking teams the best opportunity to reach maximum speed in order to create positive phases (Ross, Gill, Cronin, & Malcata, 2016; Sayers & Washington-King, 2005; Wheeler et al., 2010; Wheeler & Sayers, 2011) or score.

Descriptive statistics identified that rucks with wide 4&0 formations represented the lowest percentage of positive phases excluding foiled rucks. This is despite being the preferred attacking formation and its association with higher passing numbers. Whilst wide 4&0 formations do use three or more passes significantly more than the other formations, this passing rate is still approximately only attributed to 40% of wide 4&0 rucks. This leaves approximately 60% of 4&0 rucks with two or less passes. Findings indicated that low passing numbers were associated with neutral or negative phases more regularly from wide 4&0 formations than from the other formations. An explanation for this variation may be that tactically the defence will have a stronger understanding of which direction the attack will go compared with the other formations that develop opportunities to attack either left or right. If the defence knows the direction of the attack, they can prepare earlier and move forward at a faster rate to reduce the attacking team's time and space (Passos, Araújo, Davids, Milho, & Gouveia, 2009). This method of defence could trap the attacking team behind the gain line forcing the attacking team into negative phase outcomes. Another reason for this disparity may be due to the length of the passes required to move the ball from one side of the field to the other. Attacking from wide 4&0 formations could require longer passes, which have the tendency to be less accurate than shorter passes (Worsfold & Page, 2014). Consequently, passes may not go directly to the receiver who is forced to reduce their speed in order to effectively catch the ball. A reduction in speed would likely have a negative impact on the effectiveness of the phase by applying pressure on further passes being thrown. Alternatively, it could be speculated that the direction of the pass may be a reason for poor passing performance in 4&0 formations. It has previously been identified that passing from right to left is preferred over passing left to right due to the right hand being the dominant preferred passing hand for most players (Pavely, Adams, Di Francesco, Larkham, & Maher, 2009; Worsfold & Page, 2014). A study on first grade 15-a-side rugby union players, identified a significant reduction in both passing accuracy and length with the non-preferred passing side as well as an increased reaction time (Pavely et al., 2009). Rucks with a wide 4&0 formation spread from left to right may be more commonly associated with lower passing numbers than those spread right to left. However, a limitation of this study was that passing direction from the ruck was not taken into consideration and this aspect may warrant further investigation.

Previous literature indicated that a greater number of passes were associated with unsuccessful performance (Higham et al., 2014b; Hughes & Jones, 2005). However previous literature did not take situations into account (e.g. from rucks, kick return, counter attack). The findings from this study revealed that higher passing numbers from rucks was associated with success. This may suggest that a change in tactics, playing style or possibly a more professional approach since the earlier studies of Higham and colleagues (2014b) and Hughes and Jones (2005) (Ross et al., 2016; van Rooyen, 2016). Secondly the passing numbers from the variety of other situations besides rucks may align more closely with previously identified research (Higham et al., 2014b; Hughes & Jones, 2005). Attacking from rucks in rugby sevens is a structured attacking point. Players undergo positional coupling that are regularly used formations to attack from, therefore passing opportunities may be greater than less structured situations. Events such as a quick tap or counter attacking an error may be less likely to be proceeded by higher passing numbers as it is an unexpected opportunity where players are less likely to be positioned uniformly around the ball.

Midfield rucks with a 2&2 formation are the least common attacking formation excluding foiled rucks. 2&2 formations are associated with the highest percentage of positive phases and the least amount of negative phases, despite this formations association with lower passing numbers. To develop positive phases, midfield rucks with 2&2 formations tend to rely on the initial receiver aiming to reach a fixation point over the gain line (Passos, Araújo, Davids, & Shuttleworth, 2008). This requires the first receiver to attempt to attack an isolated defender (Wheeler et al., 2010) with the goal of crossing the gain line. Rucks with a 2&2 formation also provide the attacking team with two equal directions of attacking opportunities. This has the potential to generate more indecision within the defensive system. Combining 2&2 coupling with higher passing numbers could potentially be a highly effective combination in rugby sevens. Higher passing numbers from this formation would likely involve changes of direction in the attack. Changes of direction and running angles have previously been associated with tackle breaks and positive phases (Wheeler et al., 2010). Midfield rucks with 2&2 formations could also utilise loop passes to create an extra passing option or inside passes to change the direction of attack. Furthermore the use of effective offload passes have been associated with an increase in points (Ross et al., 2016) and may be a beneficial attacking tool from midfield rucks.

Results from this study should also assist with defensive tactics. Firstly foiled rucks are the least formed pattern providing evidence that attacking rucks in rugby sevens commonly utilise three players in total. These being a ball carrier who is tackled, one support player who rucks for the ball and one player who acts as the half back to remove the ball from the ruck. In men's rugby sevens approximately 14% of all completed rucks did not fit this profile whilst in women's rugby sevens it was less than 8% of all completed rucks. Foiled rucks were also associated with more negative phases than the alternate attacking formations. It has been identified that contesting the ruck is an effective defensive ploy (Ross et al., 2016). This tactic compels the attacking team to commit more players to the ruck creating more foiled rucks and leaving fewer players available to attack (Kraak & Welman, 2014; Ross et al., 2016). However the timing of the contest needs to be monitored with an early contest shown to slow down the attack and possibly draw in more players, but a late contest likely to concede a penalty (Wheeler, Mills, Lyons, & Harrinton, 2013).

Foiled formations are also dependent on the effectiveness of the support player in maintaining possession and removing opposition threats. Poor rucking technique can influence the ensuing attacking formation. Therefore the support role is a responsibility that all players should be highly proficient in. Research in rucking technique and ruck actions remain in their infancy and this aspect of rugby sevens play does require further research in order to identify and understand the superior techniques for rucking success.

Handling errors were also associated with negative phases. This result is in agreement with Ross et al. (2016) who discovered that handling errors were associated with a lower point score during the 2013/14 World Rugby Sevens Series. Defensive speed and pressure are likely to create errors in attack giving the defensive team opportunities to force turnovers in possession (Passos et al., 2009). When defending 4&0 rucks teams should be prepared for higher passing numbers within the phase and use speed to apply pressure on the inside distributing players to cut out the wide passing option.

This study was limited to individual phases and did not study the effect of accumulated positive phases as performed by Reed and Hughes (2006) in 15-a-side rugby union. This is due partly, to the nature of the game, where there is a limited number of repeated ruck phases taking place. Rucks were commonly followed by either a try, an error or change of possession or a penalty being awarded for a ruck infringement. Another limitation of this study was that it did not account for the result of the phase from set piece e.g. scrum, line out, penalty tap. The study also investigated all ruck options equally without comparing rucks placed within the right or left channels of the field. Further investigation could assess these aspects of the game. Furthermore the goals of any attacking team are subject to the defensive actions. While attempts to identify and employ tactics for success are warranted, athletes and coaches must develop solutions to a variation of defensive tactics in order to be successful (Passos et al., 2008).

CONCLUSIONS

Positive ruck phases are associated with success in international rugby sevens and developing tactical strategies to create forward phase momentum should form part of the preparation for coaches and teams in rugby sevens. Whilst 4&0 rucks are the most commonly utilised ruck formation they are not associated with the highest percentage of positive phases, therefore alternative formations should be also be utilised tactically. Attacking teams should aim to create opportunities to attack using three or more passes per phase and consider the possibilities of utilising changes of direction when possible. Defensive teams should aim to create pressure on teams forcing them into shapes that are associated with more negative phases and lower passing options.

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