Cardiff School of Sport

DISSERTATION ASSESSMENT PROFORMA:
Empirical [2]

Student name:	Todd Taylor	***Student ID:***	ST10001436
Programme:	SES		
Dissertation title:	TIME MOTION ANALYSIS OF AMATEUR RUGBY UNION, COMPARING THE RESULTS OF BACKS AND FORWARDS		
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Comments	Section
	Title and Abstract Title to include: A concise indication of the research question/problem. Abstract to include: A concise summary of the empirical study undertaken.
	Introduction and literature review To include: outline of context (theoretical/conceptual/applied) for the question; analysis of findings of previous related research including gaps in the literature and relevant contributions; logical flow to, and clear presentation of the research problem/ question; an indication of any research expectations, (i.e., hypotheses if applicable).
	Methods and Research Design To include: details of the research design and justification for the methods applied; participant details; comprehensive replicable protocol.
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	Discussion and Conclusions [1] To include: collation of information and ideas and evaluation of those ideas relative to the extant literature/concept/theory and research question/problem; adoption of a personal position on the study by linking and combining different elements of the data reported; discussion of the real-life impact of your research findings for coaches and/or practitioners (i.e. practical implications); discussion of the limitations and a critical reflection of the approach/process adopted; and indication of potential improvements and future developments building on the study; and a conclusion which summarises the relationship between the research question and the major findings.
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CARDIFF METROPOLITAN UNIVERSITY
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CARDIFF SCHOOL OF SPORT

DEGREE OF BACHELOR OF SCIENCE (HONOURS)

SPORT AND EXERCISE SCIENCE

TIME MOTION ANALYSIS OF AMATUER RUGBY UNION, COMPARING THE RESULTS OF FORWARDS AND BACKS

PERFORMANCE ANALYSIS

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TIME MOTION ANALYSIS OF AMATUER RUGBY UNION, COMPARING THE RESULTS OF FORWARDS AND BACKS

Cardiff Metropolitan University
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Acknowledgements

I would like to thank Lucy Holmes for the continued help she has given during the research project.

I would like to thank the players from Cardiff Metropolitan RFC for being participants in the research project. Special mention must go to Jordan Saunders.

I would like to thank David Mackie, Tobias Richards and Tom Gallagher for helping me will the data collection process.

I would like to thank my family for their continued support they have given me throughout the research project.

Abstract

The aim of the study was to get a deeper understanding into the physical demands and the work-rest periods that are placed upon amateur rugby union players. There has been limited research in the past looking at the demands placed upon amateur players. Ten games (n=10) very verbally observed, five players being forwards (n=5) and five players being backs (n=5). The movements of each player were coded into a computerised analysis system (SportsCode) using six different movement variables. One game was video recorded to allow for reliability of the analyser to be assessed. An inter-operator (k=0.72) and intra-operator (k=0.78) kappa value showed that the reliability of the analyser was good. The results of the study showed that there are some clear differences with the work rates of the forwards compared to the backs. The biggest difference found from the study between forwards and backs was duration of time spent walking and completing static activity. Forward on average were walking for 1472 ± 119.7s and involved in static activity for 650 ± 71.5s compared to the backs that were walking for 1768 ± 490.8s and involved in static activity for 407 ± 298.2s. A Mann Whitney U test showed that these results were significantly different ($p<0.01$). The work to rest ratios produced from the study were also different with forwards (1:2.3) and backs (1:3.8). Furthermore, there were some clear difference with the sprint activity of forwards and backs. The results displayed that backs completed an increased number of sprints (9.4 ± 6.3) compared to the forwards (2.6 ± 2.5). This increased number of sprints meant that the rest periods between sprints for backs were considerably lower than the forwards. However, the average duration of each sprint was very similar for forwards (4 ± 2.6s) and backs (4 ± 1.1s). These results suggest that training programmes should be tailored for individuals depending on their playing positions due to these differences in physical demands.

CHAPTER ONE

INTRODUCTION

1.1. Rugby Union

Rugby is described by Duthie *et al.* (2003) as a game that is played by two teams of 15 players, each having been assigned with a different set position. It is a physical game that is played over an 80-minute period, however, the game consists of many breakages in play during the 80-minute period. Duthie *et al.* (2003) stated that typically the ball in play (BiP) period is on average around 30 minutes. The remainder of playing time consists of injury periods, penalty attempts, conversions or simply the ball being out of play. The 15 playing positions are split into two different categories; backs and forwards. The roles of both backs and forwards are extremely different and require specific skills, i.e. second row forwards are good in lineout situations where as backs are good runners with the ball in hand. Rugby union is a contact game that requires particular somatotypes for different positions. Nicholas (1997) said that front row forwards are bigger in build as they require strength and power due to the high duration of time spent in the contact area. Back row forwards were said to be taller in stature, but still strong and powerful. Furthermore, backs were described as being smaller in build but having higher levels of muscular endurance and speed.

Understanding the physical demands of rugby union is critical as it gives coaches the opportunity to recognize the most common training programmes that should be used to help maximise playing performance. Previous research papers (Deutsch *et al.*, 2007; Roberts *et al.*, 2008) declared that coaches require an adequate understanding into the physical demands in rugby union in order to optimise the coaching experience for the athletes. This understanding will enable coaches to tailor the training programmes so they are individual specific rather than just splitting the training programmes into backs and forwards.

1.2. Purpose & Rationale of the Study

When coaches are able to acquire and correctly analyze performance, training programmes can be organized to specifically target individual faults in performance (Hökelman *et al.,* 2009).

There had been numerous studies carried out looking at the physical demands of professional rugby union (Duthie *et al.,* 2003; Duthie *et al.,* 2005; Deutsch *et al.,* 2007; Roberts *et al.,* 2008; Austin *et al.,* 2011 & Quarrie *et al.,* 2012). However,

there is limited research looking at the demands placed on amateur rugby union players. The aim of the current study was to analyze the movement patterns of amateur forwards and backs during performance. The rational for the study was to compare the physical demands that are placed on the different playing positions. This knowledge into physical demands would enable comparisons to be made between the two different positional groups, as well as allowing comparisons to be made between the demands placed on professional and amateur rugby union players. Furthermore, it will allow for coaches to create more individual specific training programmes.

1.3. Limitations

- The notational process is extremely time consuming, because of this the sample size used was small.
- Game cancellations meant that the data collection process took longer than expected

CHAPTER TWO
LITERATURE REVIEW

2.1. The Coaching Process

The aim of the coaching process is to develop performance through providing accurate, useful and timely feedback to a team or individual (Hökelman *et al*., 2009). Hughes and Franks (2008) stated that there would be no improvement in performance levels without feedback being provided from a coach or individual. However, often during the course of a game, players and coaches miss vital events that could have a significant impact on improving performance. There have been numerous previous research papers (Hughes and Franks, 2001; Hökelman *et al.,* 2009) focusing on coach memory. Both papers suggest that humans are limited with the amount of detail they can remember during the course of a game. Furthermore, both papers stated that high performance athletes need more than just human memory to help create a victorious outcome. A study by Franks and Miller (1991) showed that coaches are less than 45% accurate in a post-match interview when asked about events that took place in a game. More (2004) said that the more effective the coaching process, the more likely the athletes are to improve performance. Hökelman *et al.* (2009) stated that performance analysis could be used by coaches to pin point major faults in performance, thus helping to create the ideal training programme to help correct these faults. Hughes and Franks (2008) declared that notation analysis is a good way of recording performance, ensuring that no critical events are missed. In addition, they added that notional analysis would provide reliable quantitative and qualitative feedback to athletes.

2.2. Time Motion Analysis

Performance analysis allows for many aspects of sport to be analyzed. Hughes and Bartlett (2002) stated that the application of performance analysis has been used for technical evaluation, tactical evaluation, movement analysis, development of player profiles and education for coaches and players.

Time-motion analysis is a popular technique used within performance analysis and is used to record and analyse dynamic and complex movements (O'Donoghue, 2008). O'Donoghue (2008) declared that time-motion analysis is the investigation into the amount of work a player does during performace and is not simply the amount of work completed when on the ball. In addition, O'Donoghue (2008) said

that the purpose of this research is to develop a deeper understating into the physiological demands faced on an athlete during competition. One of the early time-motion analysis papers by Reilly and Thomas (1976) recorded work rates of football players during game time using a hand notation system and a voice recorder. The methods used in this paper allowed for the understanding of work rates of each individual playing position and total distance covered during football games. Hughes and Bartlett (2002) declared that the work completed by Reilly and Thomas (1976) has become the standard against which other time-motion analysis papers are compared. Many other researchers have duplicated this study into various different sports.

Hughes and Bartlett (2002) said that since the research of Reilly and Thomas (1976), computerized tracking systems have been developed to assist in the data collection, streamlining this process and making it a more time efficient, less stressful and easier for researchers to undertake. However, Hughes and Franks (1997) stated that although the data recording process may become easier, researchers need to be aware that this could increase operator errors or software and hardware errors i.e. pressing the wrong key when coding live sporting events.

2.3. Physical Demand in Rugby Union

Rugby union is an ever changing game. Since turning professional there has been a number of different rule changes (Austin *et al.,* 2011). Brooks and Kemp (2008) and Quarrie and Hopkins (2007) both declared that because of these changes the game in becoming faster and more physical. An early study by Deutsch *et al*. (1998) found that props and locks covered a distance of 4400m during a game, compared to back row forwards (4080m), inside backs (5530m) and outside backs (5750m). The authors declared that 15% of the game time is performing high intensity activity. Roberts *et al.* (2008) later carried out a study looking at the physical demands of the English rugby premier league. The study showed that front row forwards travelled 5408m, back row forwards 5812m, inside backs 6055m and outside backs 6190m. However, it is difficult to compare the work of Deutsch *et al.* (1998) with Roberts *et al.* (2008) due to the earlier study only analysing a 70 minute game compared to the later 80 minute period. Roberts *et al*. (2008) study revealed that backs on average sprinted 23 times during a match

compared with the forwards that only sprinted 10 times. Rugby players are now spending an increased duration of time completing high intensity running (Austin *et al.* 2011). Moreover, when comparing the work of Duthie *et al.* (2005) and Eaton and George (2006), the work to rest ratios of the players has increased with all playing positions. The results of Austin ***et al.'s*** (2011) study revealed that the distances covered by the players ranged from 5139m to 6389m. These results were similar to the results of Robert *et al.* (2008). However, comparing the findings of Austin *et al.*'s (2011) study with the work of Duthie *et al.* (2005) it is clear to see that players are spending a greater duration of time carrying out high intensity activity. Players are now spending 7% less time standing still and 4% less jogging. Moreover, the average number of sprints by all playing positional groups has increased from 18 to 40 when comparing the two studies. This suggests that the game of rugby is becoming quicker, therefore, changing the demands that are placed on athletes during a game of rugby.

2.4. Forwards vs Backs

It is clear to see that the physical demands in rugby union are ever changing. However, the sport of rugby union is made up of fifteen different playing positions. Therefore the individual demands of each playing position needs to be understood. There have been numerous studies produced comparing the physical demands that are placed upon backs and forwards (Duthie *et al.,* 2003; Duthie *et al.,* 2005; Deutsch *et al.,* 2007; Roberts *et al,* 2008.; Austin *et al.,* 2011; Quarrie *et al.,* 2012).

One of the earliest studies produced comparing the demands of forwards and backs was Docherty *et al.* (1998). The study was analysing the amount of time props and centres spent standing still, walking, jogging, running, sprinting, shuffling or involved in static activity. The results of this early study revealed that only 5-10% of the game was spent performing high intensity activity. Docherty *et al.* (1988) stated that the creatine phosphate system was the most important energy system during high intensity activity. Furthermore, the anaerobic glycolytic system was of little importance. Deutsch *et al.* (1998) carried out a study looking at the individual work to rest ratios of players during a 70 minute game. The results revealed that the work to rest ratios of forwards and backs are very

different. Forwards carried out approximately three times more high intensity work than the backs (11.2 ± 0.9s v 3.6 ± 0.5s).

The following studies by Duthie *et al*. (2003), Duthie *et al.* (2005) and Deutsch *et al.* (2007) all found that forwards spent a considerably longer duration performing high intensity activity. Duthie *et al.* (2003) and Deutsch *et al*. (2007) both focused their studies on looking at the physiological and anthropometrical demands that are placed upon different playing positions in rugby union. Both studies revealed that forwards performed a greater amount of high intensity activity due to the increased duration of time spent in and around the contact area. However, the backs travelled the greatest distance due to the increased amount of high intensity running. Although the amount of work carried out was different for backs and forwards, Deutsch *et al.* (2007) revealed that the mean duration of each activity was the same for both positional groups. The work to rest ratios produced were 1:7.4 for the forwards and 1:21.8 for the backs. Duthie *et al.* (2003) and Deutsch *et al.* (2007) both disagreed with the work of Docherty *et al*. (1988) in stating that forwards are more reliant on their anaerobic glycolytic system due to completing in more non-running activities such as scrumming, rucking and mauling. Whereas, backs are more involved in the running plays and are more reliant on their creatine phosphate system. Both concluded that rugby is a unique sport as each position has their own demands, meaning the usage of different energy systems.

Duthie *et al.* (2005) and Austin *et al.* (2011) both carried out studies looking at the high intensity demands that are placed upon players in the Super rugby competition. The studies divided the playing positions into four different catergories; front row forwards, back row forwards, inside backs and outside backs. Both studies revealed that the forwards performed an increased amount of high intensity activity. Austin *et al.* (2011) revealed that the front row forwards covered the shortest distance (5139m), whereas inside backs covered the greatest distance (6389m). However, both studies produced very different results regarding the duration of time forwards and backs spent in the contact area. Duthie *et al.*'s (2005) study found that forwards were involved in high intensity activity for 546 ± 168s, compared with the results of Austin *et al*. (2011) who said forwards were working for 1190s. Although the forwards are spending a greater duration of time performing high intensity activities, forwards are also standing still for 467s longer than the backs (Duthie *et al.,* 2005)

Although much of the previous research looking at work rates of rugby union players has been completed using southern hemisphere rugby. Roberts *et al.* (2008) carried out a study looking at the working rate of elite rugby union players who play in the English rugby league. Like many of the previous research studies, Roberts *et al.* (2008) described low intensity activity as standing, walking, jogging and high intensity activity as striding, sprinting and static exertion. Like the other previous research papers, the results of study show that backs cover a greater distance than forwards through the 80-minute period. However, the results of Roberts *et al*. (2008) are very different to the results of Deutsch *et al.* (1998). The average total distances covered during Roberts *et al.* (2008) study were considerably higher than those of Deutsch *et al*. (1998) for both backs (6217 vs. 5640m) and forwards (5581 vs 4240m). Although Deutsch *et al.*'s (1998) study was only carried out over a 70-minute period; the results of the forwards are considerably different. Roberts *et al.* (2008) stated that the differences in total distances covered could be due to the age differences of the two groups of players, with the U19 being less physically developed than the men, therefore, impacting the total distance covered. Roberts *et al.* (2008) declared that backs traveled a further distance than forwards due to the increased amount of walking being completed whilst forwards were performing static activities around the contact area. The results of Roberts *et al.*'s (2008) study were very similar to those of Duthie *et al*. (2005). The percentage of high-intensity and low-intensity activity was 14% high, 86% low compared to 12% high, 88% low. The results of these two studies suggest that the physical demands of the English rugby league are very similar to those of the Super 12. However, the average sprint duration between the northern and southern hemisphere rugby are very different. The results of Roberts *et al.*'s (2008) study show that the average sprint duration for both backs and forwards was 1.2 seconds. Deutsch *et al*.'s (2007) study found that the average sprint duration for forwards and back was 2.0 seconds and 3.2 seconds respectively. Roberts *et al.* (2008) declared that one of the possible reasons behind the variation in sprint duration is due to the climate differences. Southern hemisphere sides are playing on turf that is much firmer compared to northern hemisphere teams who play on a much softer surface. Roberts *et al*. (2008) concluded that the reasoning behind backs traveling a greater distance during the course of the game was due to the increased amount of walking being

completed whilst the forwards were carrying out high intensity activity in the contact area.

Quarrie *et al.* (2012) completed a study looking at the positional demands of international rugby performance. The rational for the study was to get a deeper understanding into the physical demands that are placed upon the different positional groups during performance. The study was carried out using the New Zealand national rugby team (the All Blacks). 763 players were coded from recordings of 90 international games between 2004-2010. The study showed that forward were involved in scrums, rucks and mauls for about three and a half minutes during the course of a game, compared to backs that are involved for less than a minute. Quarrie *et al*. (2012) stated that forwards on average are typically involved in about 25 scrums per game. However, the physical demands that are placed upon the different positions in the scrums are unique. Front row forwards endure heavy loads in each scrum, whereas back row forwards physical demands are not as straining. Gill *et al.* (2006) found that the degree of muscle damage after performance was related with the number of contacts a player sustains, and full recovery takes up to 84 hours post match. Quarrie *et al.* (2012) concluded that coaches and staff need to consider the number of contacts and distance covered when planning training and recovery strategies. Previous research has tended to categories hookers as having the same movement patterns as the loose forwards (Duthie *et al.,* 2005; Deutsch *et al*., 2007). However, Quarrie *et al.* (2012) declared that hooker's movement patterns are more similar to those of the locks and the props. The authors stated that one of the possible reasons behind the differences in movement patterns is due to the hookers finding it more difficult to break themselves away from the scrums and move to the next phase of play, compared to the loose forwards who can easily break away from the scrum. The backs movement patterns during the course of a game are very different. Quarrie *et al.* (2012) said that scrums-halves and fly-halves have very distinct movement patterns, this is due to the high number of times that they touch the ball during play. Quarrie *et al.* (2012) study agreed with those of Duthie *et al.* (2005), Roberts *et al.* (2008) and Austin *et al.* (2011) in stating that scrum-halves should not be linked with the other backs. The authors said that a scrum-half has a specialized role, which requires them to be at the majority of rucks and mauls. Scrum-halves

covered the greatest distance out of the backs traveling at speeds from 4.0 to 6.0ms but covered the shortest distance traveling at maximal sprint speeds (>8.0 ms). Outside backs covered the greatest distance walking and in utility movement (>2.0 ms) than any other positional group, however, covered the greatest distance at maximal sprint speeds (>8. ms).

2.5. Rationale for the Study

The rational for this study is to get a deeper understanding into the physical demands and the work-rest periods that are placed upon amateur rugby players. There has been limited research in the past looking at the demands placed upon amateur players. Through producing work-rest data for amateur rugby players it will allow for these results to be compared to the results of previous studies. This will enable an understanding into how the physical demands of the amateur game compare to those of the professional game.

CHAPTER THREE

METHOD

3.1. Participant

Video analysis was carried out on 10 (n=10) Cardiff Metropolitan University rugby union players through the 2012/2013 SWALEC championship season. All games that were analysed were played at UWIC University (pitch 1). The following positions were analysed during the study; front row forward (prop and hooker), second-row forward, back row forward (flanker & number 8), scrum-half, fly-half, centre, wing and fullback. The movement patterns of all 10 participants were analysed. All participants gave informed consent before the study began.

3.2. Game Analysis

Recordings of each different playing position was carried out using a Dictaphone (IPhone 5, Apple Inc., CA, USA). A Dictaphone would allow for the movement descriptors of each player to be recorder verbally. Analysis was carried out from an elevated position on the halfway line, approximately 15m away from the playing field. This elevated position allowed for the whole playing field to be clearly seen. Four games were analysed during the study, Table I shows the results of these games.

Table 1. Results of the four different games of the data collection.

Game	Outcome	Score
Game 1	Lost	09-12
Game 2	Won	16-09
Game 3	Won	44-05
Game 4	Won	25-10

Four assistants were used during the course of the data collection. These assistants were briefed in detail what the project entailed and the overall rationale for the study. Furthermore, the assistants had a familiarisation session before the first game to ensure that there was a clear understanding into the operational definitions being used through the study.

Before each game, it was decided which players would be analysed during the course of the 80 minutes. Once the game began, all movements were recorder. It

was vital that the observers concentrated during the whole 80-minute period to ensure that no key movement locomotion's were missed. Data recording was paused during the half time break and restarted at second half kick off. Like the study of Eaton *et al.* (2006) if our chosen player was substituted before the end of the game, the remaining data collection would be carried out on the player that has been substituted on. There were six different movement locomotion's used to described the movements of the athletes; standing, walking, jogging, striding, sprinting and static activity (further description in the operational definitions). The data collector was simply asked to categories what movement locomotion was being carried out. Every time the athlete changed there locomotion the observer simply had to state what the movement locomotion has changed too (i.e. walking – jogging). One game was video recorded with a Sony A1E camera. This was done for reliability purposes, as it would allow for inter-operator and intra-operator reliability to be tested. Once all ten games had been recorded the data was transferred onto a IMac (Apple Inc., CA, USA) as an MPEG-4 file using a lighting to USB cable. After all files had been exported, sports code was opened and a new timeline was created. Sports code requires a movie file in order for data to be coded into a timeline. Due to using voice recordings, each timeline was assigned with a blank movie to enable the data to be coded. Sports code was the preferred software to be used as it enables the voice recordings to be re-wound and fast-forwarded. This ensured that any mistakes that are made during the coding process could be corrected. The data was entered into studio code through the creation of six different buttons, each being a different movement locomotion (see figure 1). A hot key was assigned to each button, this made the coding process easier. To ensure that only one button could be coding at one time, each button had an exclusive link. This link ensured that when a button was activated, the previous coding buttons would be switched off automatically. Once the coding of each game had been carried out, data frequency reports were created and exported onto a excel spreadsheet. These spread sheets showed how long each movement locomotion was carried out for as well as showing the amount of times each activity was carried out. Furthermore, these spreadsheets allowed for a deeper understanding into repeated sprint activity, due to showing us how many sprints were completed as well as the mean duration of the sprints. Once all the individual data was collected, means and standard deviations of all the results

were created to show the average work-rest ratio of an amateur rugby union player.

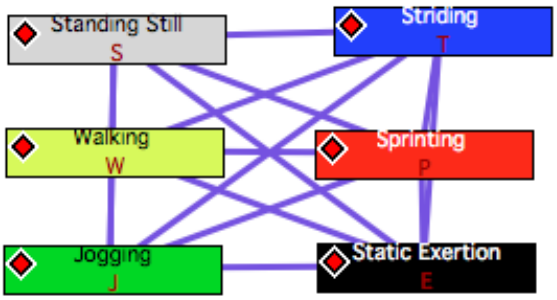

Figure 1. The window used for coding

3.3. Operational Definitions

Before any data collection could be carried out it was essential that there was a clear understanding into the different operational definitions that were going to be used through the study. Previous research papers have used different operational definitions for different movement locomotion's. The operational definitions used through the study were created based on previous research (Deutsch *et al* 1998b; Docherty, Wenger & Neary. 1988; Duthie *et al.* 2005).

The different operational definitions used through the study were as following:

Standing Still: When the player is either standing or lying on the ground making no/little movement. (E.g. waiting for scrum or lineout).

Walking: when a player is making a slow but purposeful movement. (E.g. walking forwards, backwards & side to side to a breakdown).

Jogging: A slow run forwards or backwards as well as a slow side-to-side movement. (E.g. shifting side-to-side when drifting as a defence or jogging to a break down situation).

Striding: A quick jog that shows a clear acceleration and effort to maximise stride length but is not a maximal sprint.

Sprinting: A maximal effort run.

Static Exertion: A movement that requires individuals to exert themselves in an action that doesn't require a specific movement. (E.g. Rucking, mauling, scrummaging, tackling etc).

3.4. Data Analysis

Each of the six movement locomotion were analysed to calculate the mean and standard deviation for the following:

Frequency – the total amount of times each particular movement locomotion was carried out.

Mean Duration – the average time period in which a participant carried out a particular movement.

% movement – the percentage of time in which an athlete completes each particular movement locomotion

Work to rest ratios and repeated sprint activity data was also created.

3.5. Statistical Analysis

Statistical Software Package for Social Sciences (SPSS, Chicago, IL) alongside Excel was the software chosen for carrying out the statistical testing. SPSS aloud for a Mann-Whitney U test to be carried out to measure the significant differences between the two different positional groups. The level of significance was set at 95% ($p<0.05$).

3.6. Reliability

‘The Repeatability and accuracy of a study is a central facet to notational analysis.’ (Hughes, 2008. Pp. 143). James *et al*. (2007) declared that there are three different sources of error; observational error, operational error and definitional error. The biggest cause for error related with analysing game events are definitional errors, for example, labelling a pass as successful when it was in fact unsuccessful (James *et al*., 2007).

Without performing a reliability test the results produced from the study wouldn’t be valid. Therefore it was essential that reliability was tested. Measuring the reliability of the analysing process was carried out through doing a intra-analyst test and a inter-analyst test. Inter-analyst test is where two people code the same event separately and the results are compared. Whereas, an intra-analyst test is where the same person codes the same event twice (James *et al*, 2007). James *et al.* (2007) said that both these tests could give a good indication into the accuracy of the analyst. However, an inter-analyst test has the advantage of distinguishing misinterpretations of operational definitions through having two analysts. Both these test were carried out.

Once both the inter-analyst test and intra-analyst test had been carried out, Kappa values were calculated. Kappa was described by Altman (1991) as being a statistic that is used to evaluate the reliability of an independent assessment. Kappa values verify the extent to which independent observers agree, leaving out the proportion that could have been agreed by chance (Robinson and O’Donoghue, 2007). The kappa values were created calculated in a Microsoft Excel spreadsheet. Kappa values range from 1-0. A kappa value of 1 is the strongest result of agreement, whereas, a result of 0 shows that there is no agreement between the observers. The result of the intra-analyst test was 0.79 compared with the result of the inter-analyst test 0.75. According to Altman (1991) these results are a good strength of agreement

CHAPTER FOUR

RESULTS

4.1. Locomotion Count

The study discovered that the physiological demands placed upon back and forwards in amateur rugby union players are very different. The results show that forwards change movement locomotion 647 ± 33.1 times during the course of a game compared to the backs that change movement locomotion 623 ± 66.3 times. Table 1 demonstrates the individual count for each different movement locomotion. It is clear to see that the count for standing still and jogging are very similar with forward and backs. The clear dissimilarity that is noticeable from the table of results is the difference in count for static exertion, walking, striding and sprinting. Forwards are shown to have a considerably higher count of static exertion, whereas, backs have a significantly higher count of walking, striding and sprinting. A Mann-Whitney U test was carried out and showed that there was no significant differences with the count of each locomotion other than static exertion ($p<0.01$).

Table 2: Count of each Movement locomotion

Locomotion	Forwards (n=5)	Backs (n=5)	All (n=10)
Standing Still	183 ± 22.7	173 ± 38.4	177 ± 30.0
Walking	216 ± 23.0	241 ± 10.5	227 ± 23.0
Jogging	145 ± 18.4	147 ± 27.3	146 ± 22.0
Striding	9 ± 13.7	30 ± 13.1	23 ± 14.9
Sprinting	2 ± 2.5	9 ± 6.3	6 ± 5.8
Static Exertion	86 ± 14.2	22 ± 6.5	56 ± 36.5 **

* Significant difference between forwards and backs ($p<0.05$)
** Significant difference between forwards and backs ($p<0.01$)

4.2. Frequency of Locomotion

Table 2 displays how the frequency of each movement locomotion is very different depending on your playing position. The table displays that there are clear differences between backs and forwards. Forwards spend a greater duration of time standing still and involving them selves in static activity. While backs perform a much greater amount of time walking, striding and sprinting. A Mann-Whitney U test was carried out and showed that there was a significant differences with the frequency of static exertion and walking when comparing the forwards and backs. ($p<0.01$).

Table 3: Total duration of each movement locomotion (secs)

Locomotion	Forwards (n=5)	Backs (n=5)	All (n=10)
Standing Still	2014 ± 257.5	1731 ± 328.5	1885 ± 311.8
Walking	1472 ± 119.7	2214 ± 347.5	1768 ± 490.8 **
Jogging	818 ± 123.7	768 ± 200.9	795 ± 159.0
Striding	38 ± 41.2	98 ± 55.5	143 ± 54.4
Sprinting	9 ± 7.2	45 ± 42.9	28 ± 34.5
Static Exertion	650 ± 71.5	115 ± 46.5	407 ± 298.2 **

* Significant difference between forwards and backs ($p<0.05$)
** Significant difference between forwards and backs ($p<0.01$

4.3. Mean Duration

Table 3 shows the average duration of each movement locomotion for backs and forwards. The results show that the mean duration of each locomotion was very similar for both forwards and backs. The most noticeable differences that can be seen from table 1 is that forwards spent a mean of three seconds longer when involved in static activity than backs. Furthermore, forwards spent an average of one second longer when standing still or jogging. Backs spent a mean of two seconds longer when carrying out a walking locomotion. A Mann-Whitney U test didn't find any significant differences when comparing the mean duration of each movement locomotion between backs and forwards.

Table 4: Mean duration of each movement locomotion (secs)

Locomotion	Forwards (n=5)	Backs (n=5)	All (n=10)
Standing Still	11 ± 1.2	10 ± 2.1	11 ± 1.7
Walking	7 ± 0.8	9 ± 1.4	7 ± 1.6
Jogging	6 ± 0.5	5 ± 0.7	5 ± 0.6
Striding	3 ± 0.5	3 ± 0.5	3 ± 1.1
Sprinting	4 ± 2.6	4 ± 1.1	3 ± 2.1
Static Exertion	8 ± 1.1	5 ± 2.5	5 ± 2.2

* Significant difference between forwards and backs ($p<0.05$)
** Significant difference between forwards and backs ($p<0.01$

4.4. Percentage Breakdown

Figure 2 shows the percentage breakdown of each movement locomotion for both backs and forwards. From the figure it is clear to see some distinct differences between each movement locomotion. The column shows that backs are forwards both stand still for a similar duration during a rugby match (40% & 35%) as well as completing a similar amount of jogging (16% & 15%). It is clear to see that the greatest differences between forwards and backs is walking and static exertion. Backs spend a much greater amount of time walking (45%) compared to forwards (29%). Moreover, forwards spend a greater amount of time (13%) involved in static activity compared to backs (2%). Striding and sprinting is carried out 1% and 0.2% of the time for forwards and 2% and 1% for backs.

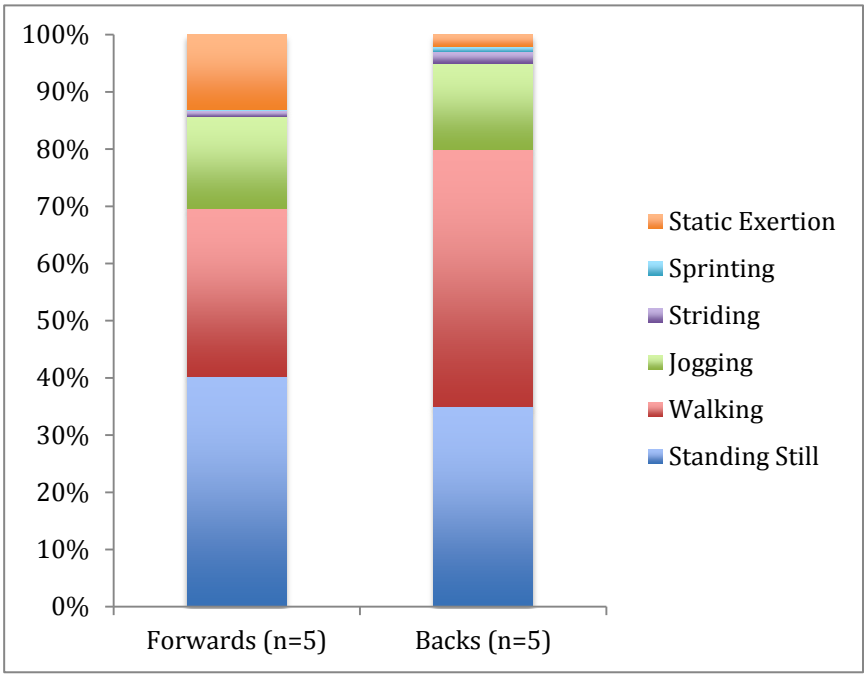

Figure 2: Percentage breakdown of each movement locomotion for backs and forwards

4.5. Work and Rest

The work to rest ratios between forwards and backs in amateur rugby union are very different. Table 4 displays the differences between the work/rest ratios of backs compared to forwards. It is clear to see that forwards partake in a considerably higher amount of work activities than backs. The results showed that forwards are working 31% of the time compared to backs that are only working 21% of the time. The work to rest ratio for forwards was 1:2.3 compared to that of backs which was 1:3.8.

Table 5: The work to rest ratios of forwards compared to backs

Variable	Forwards (n=5)	Backs (n=5)	All (n=10)
Work (secs)	1520 ± 110.6	1027 ± 182.4	1296 ± 302.5
Rest (secs)	3409 ± 235.8	3945 ± 188.5	3653 ± 349.0
% Work	31%	21%	26%
% Rest	69%	79%	74%
Ratio	1:2.3	1:3.8	1:2.8

4.6. Repeated Sprint Activity

Table 5 shows the sprint activity of each playing position. The results show that backs partake in a higher amount of sprint activities than forwards. Although the average sprint durations with the forwards and backs are very similar it is clear to see that backs maximum sprint duration is significantly higher than that of the forwards. The average number of sprints for forwards is 2.6 ± 2.5 compared to the backs that on average sprint 9.4 ± 6.3 times. There is also a considerable difference in time between sprints. The forwards on average have 1283 ± 1212 seconds between each sprint compared to the backs that only have 541 ± 292 seconds.

Table 6: Sprint activity for each different playing position

	Number of Sprints	Longest Sprint (s)	Mean Sprint Duration (s)	Mean duration between sprints (s)
Prop	1	4	4	
Hooker	1	0.3	0.3	
2nd Row	2	8	7.5	2682
Flanker	2	4.5	4.5	590
Number 8	7	5	3	577
Scrum-Half	6	7	4.4	960
Fly-Half	7	6.5	3	719
Centre	4	5	4	333
Wing	10	8	4	433
Fullback	20	8	6	259

CHAPTER FIVE

DISCUSSION

5.1. Introduction

This section will discuss the results found from the current study and compare them to the findings of previous research studies. The present study looks at how the physical demands of amateur rugby union compares to that of the professional game. The variables used during the study to understand the demands placed upon the players were; count of each locomotion, total time of each locomotion, percentage of each locomotion, mean time of each locomotion and work to rest ratio (W:R). Each variable will be covered in this section comparing the results of the forwards with the backs.

There has previously been limited research looking at the physical demands in amateur rugby union. The results produced from this study with enable coaches and physiotherapist to the have a deeper understanding of the demands placed upon their rugby players. Thus it will enable coaches to be more positional specific when creating individual training programmes resulting in the coach being able to optimise the coaching experience for the athlete (Deutsch *et al.*, 2007; Roberts *et al.*, 2008).

5.2. Duration of Locomotion

The results from the study showed the total time spent in each locomotion is markedly different for forwards and backs. Comparisons to previous literature indicates some clear similarities in the results. Deutsch *et al.* (2007) found that forwards are backs stand still for an average of 2862 ± 276s and 2466 ± 330s per game respectively. Whereas the current study found that forwards on average stand still for 2014 ± 258s compared with 1731 ± 328s for the backs. It is clear to see that forwards on average are standing still for considerably longer than the backs. A lot of the standing still for forwards took place whilst waiting for a scrum to take place. Docherty et al. (1988), Treadwell (1988) and Deutsch et al. (1998) also found that forwards spend a greater duration of time standing still than backs. They stated that this is most commonly due to the greater distances covered in repositioning movement as a player moves away from the contact area. Although it is clear to see some obvious differences with overall duration of standing still for back and forwards. The study revealed that the mean duration of each individual stand is very similar (11± 1.2s v 10 ± 2.1s). This similarity is most commonly due

to forwards and backs standing still for the same amount of time when an injured athlete is receiving treatment or a team is waiting for a place kick to be taken.

Docherty et al. (1988), Treadwell (1988) and Deutsch et al. (1998) stated that this increased amount of time spent standing still for forwards links with the amount a time a back spends walking. There was a significant difference when comparing the amount of time performing a walking locomotion with the backs and forwards. Backs were on average walking for 2214 ± 348s compared with the forwards 1472 ± 120s. Again these results are very similar to the research of Deutsch *et al.* (2007) who found that backs were walking 1944 ± 504s and forwards 1074 ± 504s.

Surprisingly the results showed that forwards completed a jogging locomotion for longer than the backs on average. Deutsch *et al.* (2007) said that this increased duration of a jogging locomotion is due to forwards repeatedly following the ball as it moves around the field to get to the breakdown. The flanker recorded the longest duration out of the forwards for jogging (953s). However, it was the scrum-half who carried out a jogging locomotion for the longest total duration (968s). This increased jogging duration is due to the scrum-half having a specialised role that requires them to be at the majority of rucks and mauls (Duthie *et al.,* 2005 and Austin *et al*., 2011).

The biggest difference found in the current study compared to previous studies was stride and sprint duration. It is shown that backs partake in an increased total duration of striding and sprinting compared to the forwards. Backs on average are striding and sprinting for a total duration of 98 ± 55.5s and 45 ± 42.9s compared with the forwards who are striding and sprinting for 38 ± 41.2s and 9 ± 7.2s. When looking at specific positions (see appendix) the fullback had the greatest total duration of both striding (196s) and sprinting (120s) where as the hooker had the lowest (18s & 1s). These results are very similar to those of Deutsch *et al*. (2007) who also declared that the outside backs are striding and sprinting for the longest duration due to having to cruise whilst in defence and sprint in attack. However the results of Austin *et al.*'s (2011) study are noticeably different compared to the results of the current study and Deutsch *et al.* (2007). Austin *et al.* (2011) found

that on average front-row forwards were sprinting for 110 ± 36s and inside-backs were sprinting for 203 ± 47s. Although the trend is the same with backs completing a greater duration of sprints than forwards, the results are noticeably greater. One of the possible reasons behind this substantial difference in results could be due to Austin *et al.* (2011) carrying out their study on southern hemisphere rugby. Roberts *et al*. (2008) declared that one of the possible reasons behind the variation in sprint duration is due to climate differences. Southern hemisphere teams play on turf that is much firmer than northern hemisphere teams allowing for a quicker game of rugby to be played.

The contact area contributes to a large majority of work for the forwards. Previous research papers have all found that forwards spend a considerable greater duration of time performing static activity compared to the backs (Duthie *et al.*, 2003; Duthie *et al.*, 2005; Eaton *et al.,* 2006; Deutsch *et al.,* 2007; Austin *et al*, 2011). The results of the current study showed some similarities when being compared to the previous studies. On average the forwards were involved in static activity for 650 ± 71.5s compared to the backs that only worked for 115 ± 46.5s. Furthermore, it was revealed that the mean duration of an individual bout of static activity is extremely different when comparing the two positional groups. Forwards spent an average of 8 ± 1.1s when carrying out each static activity compared to the backs that only spent 5 ± 2.5s. The reasoning behind this increased mean duration for forwards compared to the backs is unknown. Static activity was categorised as rucking, mauling, tackling, scrummaging and lineout work, meaning it is difficult to compare the results because backs don't partake in any scrummaging or line out activity. This is one of the major limitations of the current study. The number 8 was involved in the greatest duration of static activity (802s) compared to the scrum-half who performed the least (48s). These results are noticeably larger than the previous studies. This is due to the previous studies (Duthie *et al.*, 2005; Eaton *et al.,* 2006; Deutsch *et al.,* 2007; Austin *et al.*, 2011) only considering static exertion as either rucking or mauling, whereas, the current study also classified scrummaging and lineout work as static exertion. Quarrie *et al*. (2012) found that forwards are involved in scrums for an average of three and a half minutes per game. Due to this it is very difficult to get a true understanding into the differences in static activity between backs and forwards.

5.3. Work to Rest Ratio

The understanding of work to rest ratios is key as it allows for a deeper understanding into the physiological requirements of the game of rugby union (Duthie *et al.,* 2003). Furthermore, Duthie *et al.* (2005) later declared that work to rest ratios can assist in the creation of individual training programmes. The recorded work to rest ratios for this study was 1:2.3 for the forwards and 1:3.8 for the backs. The forwards on average worked for 10% longer than the backs. This increased work duration is due to spending a considerable larger amount of time in and around the contact area (Duthie *et al.,* 2005; Eaton and George, 2006).

Previous studies show that the work to rest ratios of forwards and backs are very different. (Duthie *et al.,* 2003; Duthie *et al.,* 2005; Eaton and George, 2006; Deutsch *et al.,* 2007; Austin *et al.,* 2011) However, the work to rest ratios produced from these studies are substantially different from each other. This difference could be due to a disagreement into the definition of work and rest between the authors. The current study classified jogging, striding, sprinting and static exertion as work. Deutsch *et al.* (2007) regarded cruising, sprinting, rucking/mauling, scrummaging and tackling as work activities. The most obvious difference between the current study and Deutsch *et al*. (2007) study is the classification of jogging as a working locomotion. Therefore, it is obvious to understand why the work to rest ratios produced from the current study differ from other studies.

5.4. Repeated Sprint Activity

Having an adequate understanding into repeated sprint activity allows for coaches to be able to adapt training plans to be more positional specific, thus, optimising the coaching experience for the athlete (Eaton and George, 2006; Deutsch *et al.*, 2007; Roberts *et al.*, 2008).

Austin *et al.* (2011) said that repeated sprints most commonly occur at important times during performance, and, the ability for players to perform repeated sprints may increase the chances of a victorious outcome. Previous research shows that on average forwards performed a sprint 16 times compared to backs that sprinted 23 times on average (Roberts *et al*. 2008). The current study found that on

average forwards performed 3 sprints compared to the backs that performed 9 sprints. These results are substantially different from each other, the reasoning behind this is most probably due to having different perceptions of what a maximal sprint is. The mean sprint durations between each playing position wasn't too dissimilar on average. The fullback had the greatest mean sprint time (6s) compared to the hooker who had the lowest (0.3s). Due to the number of sprints being different with forwards and backs, the mean duration between sprints was considerably different. Forwards on average have a 1283 ± 1212s between each sprint compared to the backs that only had 541 ± 292s between each sprint. Sprinting activity contributed for 0.2% of all movement locomotion's compared to backs that were sprinting for 0.85% of the time. When comparing these figures to the work of Deutsch *et al.* (2007) the results aren't too dissimilar. Deutsch *et al.* (2007) found that on average forwards and backs are sprinting for 0.2% and 0.59% of the game. As well as spending a greater duration of time performing a sprinting locomotion, backs also had a larger average maximal sprint time (4.28s) compared to the forwards (3.56s). The results produced from this study concur with the work of Eaton and George (2006) in showing that there are clear positional differences when looking at the physiological demands of the different playing positions.

5.5. Implications for Fitness Training

Quantifying the energy demands in rugby union is extremely difficult due to the variability into the amount of movement that can be performed during the course of a game (Duthie *et al.,* 2003). Duthie *et al.* (2003) stated that rugby union is a sport that is explosive in nature, meaning that the majority of work in rugby union is anaerobic. This means our bodies are heavily reliant on our anaerobic glycolysis system. Deutsch *et al*. (2007) said that the anaerobic glycolysis system supplies a rugby player with 50% of the energy required during a game of rugby. The results of the current study show that backs are resting for a considerably longer duration that the forwards. Having this increased recovery period means that the phosphate creatine system will have an important role with the back positions (Balsom *et al.,* 1992). However, Deutsch *et al.* (2007) declared that there would be stages in the game when the creatine phosphate wouldn't fully replenish

meaning an increased reliance on our anaerobic glycolyctic system. This means that training programmes for backs should be planned to ensure that there is a sufficient amount of recovery to ensure the full replenishment of the glycolyctic system. Deutsch *et al.* (2007) said that backs training plans should also focus of speed development due to their increased amount of sprints compared to forwards.

With the forwards being involved in more work activities, they have a decreased amount of rest period. This reduced rest period means that the glycolyctic energy system isn't as heavy relied on with the forwards. This is due to the insufficient time for the replenishment of creatine phosphate (Gaitanos *et al.,* 1993; Greenhaff *et al.,* 1994). With the anaerobic glycolyctic system being such an important energy source in rugby union it is essential that coaches plan training programmes to optimise the usage of the anaerobic glycolyctic system.

5.6. Limitations of the Study

There are two major limitations in the current study. The first being the sample sized used during the data collection. With the sample size only being 10 players, one from each different playing position, it is difficult to get a true understanding into the amount of work each player performs. For example, one game that was analysed had a considerably higher amount of stoppages compared the other three games. These stoppages mean that on a whole each playing position will be performing an increased amount of low intensity activity. If the sample size used were increased, it would mean each playing position would be analysed more than once removing any games that have unusual movement patterns.

The second key limitation in the study is the classification of scrummaging, mauling and lineout work as static exertion. Previous research has tended to be more specific with movements that are classed as static exertion (Deutsch *et al.,* 2007; Duthie *et al.*, 2003; Duthie *et al.*, 2005 & Eaton and George, 2006). The current study classified rucking, mauling, scrummaging, tackling, and lineout work all as static activity. This meant that it was extremely difficult to get a true comparison into the different amounts of static activity the forwards and backs do. If static exertion was classified as only rucking and mauling a better comparison

could be made between the forwards and backs. Not only would it give a better comparison into the amount of static activity backs and forwards complete, splitting scrummaging into its own movement locomotion would allow for a deeper understanding into the demands placed upon forwards whilst in the scrum.

CHAPTER SIX

CONCLUSION

6.1 Summary

The results of the current study show that the demands placed up amateur rugby union players are different for each playing position. Like the previous research, (Duthie *et al.,* 2003; Duthie *et al.,* 2005; Deutsch *et al.,* 2007; Roberts *et al.,* 2008; Austin *et al.,* 2011; Quarrie *et al.,* 2012) the study has displayed that the physical demands placed upon forwards and backs are extremely different. It can be seen that forwards spend a considerably longer duration of time performing high intensity activity due to their increased amount of time in and around the contact area. This increased amount of static activity meant that the works to rest ratio for the forwards was greater than the backs. However, backs were involved in a greater amount of running plays; this was displayed through having an increased duration and frequency of strides and sprints. Although the duration of time spent completing each movement locomotion was different, it is clear to see that the mean duration of each locomotion for forwards and backs are very similar. Overall, it can be concluded that the demands placed up forwards and backs are extremely different. Coaches and training staff need to consider the differences in demands to ensure that players are set the correct training programmes to help aid performance.

6.2 Practical Implications & Recommendations for Future Research

There is still limited research in the field of performance analysis looking at the physical demands of amateur rugby union. Future research should focus on looking at the physiological demands placed on amateur rugby union players. However, the data collection should be carried out using numerous amounts of teams to ensure that team characteristic doesn't have any effect on the results produced.

If a future paper is carried out looking at the time motion analysis of amateur rugby union players, the researcher need to consider the amount of time forwards spending participating in the scrums and line-outs. It is recommended that the researcher is more specific amount what is classed as static activity. When classifying scrummaging as static activity it is very difficult to get a true

comparison of the amount of time forwards and backs spend partaking in static activity.

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APPENDICES

APPENDIX A

Variable	Significant value
Standstill Total	0.251
Walking Total	0.009
Jogging Total	0.754
Striding Total	0.117
Sprinting Total	0.076
Static Exertion Total	0.009
Stanting Still Mean	0.387
Walking Mean	0.240
Jogging Mean	0.339
Striding Mean	0.058
Sprinting Mean	0.331
Static Exertion Mean	0.113
Work	0.009
Rest	0.028
% Standing Still	0.138
% Walking	0.008
% jogging	0.753
% Striding	0.069
% Sprinting	0.059
% Static Exertion	0.008
Count Static Exertion	0.600
Count Walking	0.028
Count Jogging	0.917
Count Striding	0.209
Count Sprinting	0.035
Count Static Exertion	0.009

APPENDIX B

CARDIFF METROPLOLITAN
INFORMED CONSENT FORM

CSS Reference No:
Title of Project:
Name of Researcher:

Participant to complete this section: Please initial each box.

1. I confirm that I have read and understand the information sheet dated ……. for this evaluation study. I have had the opportunity to consider the information, ask questions and have had these answered satisfactorily. ☐

2. I understand that my participation is voluntary and that it is possible to stop taking part at any time, without giving a reason. ☐

3. I also understand that if this happens, our relationships with the Cardiff Metropolitan University, or our legal rights will not be affected ☐

4. I understand that information from the study may be used for reporting purposes, but I will not be identified. ☐

5. I agree to take part in this study. ☐

_____
Name of Participant

_____

_____
Signature of Participant
Date

_____

_____
Name of person taking consent
Date

_____

Signature of person taking consent

* When completed, one copy for participant and one copy for researcher's files.

APPENDIX C

Participant Information Sheet

Project Title: TIME MOTION ANALYSIS OF AMATEUR RUGBY UNION, COMPARING BACK WITH FORWARDS

This document provides a run through of:

1) the background and aim of the research,
2) my role as the researcher,
3) your role as a participant,
4) benefits of taking part,
5) how data will be collected, and
6) how the data / research will be used.

The purpose of this document is to assist you in making an *informed* decision about whether you wish to be included in the project, and to promote transparency in the research process.

1) Background and aims of the research

Previous research has shown that work-rate ratios of rugby union players are very different depending on playing position. Studies have shown that the duration of work is lower with back compared to forwards. This was mainly due to forwards spending a greater duration of time in and around the contact area (i.e. rucking and mauling). Backs however, spend a greater duration of time carrying out high intensity running. The aim of the proposed study is to investigate how work to rest ratios change depending of playing positions in amateur rugby union. The results produced will be compared to that of previous research showing work-rest ratios of professional rugby union players.

2) My role as the researcher:

The project involves me (Todd Taylor), the researcher, to watch 10 rugby union games and use a Dictaphone to record what type of physical exercise/no exercise a rugby player is doing through a 80-minute period. Once information has been gathered it will be my job to input the recordings into studiocode to allow for the data to be produced.

3) Your role as a participant:

Allow the researcher to record data of their 80-minute performance using a Dictaphone.

4) Benefits of taking part:

The data that will be produced from the study will become available to all participants. This information will allow for participants to have a deeper understanding into the amount of time they spend completing different types of exercise. Through having their own data, participants will be able to compare their own results against the results of the professionals.

5) How data will be collected:
Verbally, Using a Dictaphone

6) How the data / research will be used:
The data that has been gathered for each participant will be inputted into studiocode to allow for a data frequency report to be produced. The data for all 10 participants will be compared and mean values will be produced in order to see the average work-rest ratios of an amateur rugby union player. All information gathered through the study will be confidential.

In agreeing to become a *voluntary* participant, you will be allowing me to use your responses to the questionnaires and include them within a larger data set that includes the data of other participants. Your personal data will be anonymous and will not be reported alone, but within the total sample of participants.

Your rights

Your right as a *voluntary* participant is that you are free to enter or withdraw from the study at any time. This simply means that you are in full control of the part you play in informing the research, and what *anonymous* information is used in its final reporting.

Protection to privacy

Concerted efforts will be made to hide your identity in any written transcripts, notes, and associated documentation that inform the research and its findings. Furthermore, any personal information about you will remain *confidential* according to the guidelines of the Data Protection Act (1998).

Contact

If you require any further details, or have any outstanding queries, feel free to contact me on the details printed below.

Todd Taylor

Cardiff School of Sport
Cardiff Metropolitan University
CF236XD, United Kingdom
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Appendix D

Statistics for Prop 1.

Number of rows: 6

Name	count	total time	%	mean time

Jogging	133	00:14:23.01	17.73	00:00:06.48
Static Exertion	68	00:09:34.61	11.81	00:00:08.45
Standing Still	181	00:34:58.73	43.12	00:00:11.59
Walking	232	00:21:47.85	26.87	00:00:05.63
Striding	5	00:00:11.03	0.23	00:00:02.20
Sprinting	1	00:00:04.05	0.08	00:00:04.05

Statistics for Hooker.

Number of rows: 6

Name	count	total time	%	mean time
Jogging	143	00:11:25.17	13.18	00:00:04.79
Static Exertion	87	00:11:17.86	13.04	00:00:07.79
Walking	227	00:23:00.31	26.55	00:00:06.08
Striding	6	00:00:15.18	0.29	00:00:02.53
Standing Still	209	00:39:54.26	46.05	00:00:11.45
Sprinting	1	00:00:01.46	0.03	00:00:01.46

Statistics for 2nd Row.

Number of rows: 6

Name	count	total time	%	mean time

Jogging	151	00:14:41.70	18.14	00:00:05.83
Static Exertion	107	00:11:51.95	14.64	00:00:06.65
Standing Still	200	00:29:31.78	36.44	00:00:08.85
Walking	224	00:24:16.95	29.97	00:00:06.50
Striding	5	00:00:16.58	0.34	00:00:03.31
Sprinting	2	00:00:15.07	0.31	00:00:07.53

Statistics for Flanker.

Number of rows: 6

Name	count	total time	%	mean time
Jogging	176	00:15:53.02	19.62	00:00:05.41
Walking	178	00:21:27.38	26.5	00:00:07.23
Standing Still	160	00:32:09.07	39.72	00:00:12.05
Static Exertion	91	00:09:04.98	11.22	00:00:05.98
Striding	33	00:01:44.08	2.14	00:00:03.15
Sprinting	2	00:00:08.89	0.18	00:00:04.44

Statistics for Number 8.

Number of rows: 7

Name	count	total time	%	mean time

Jogging	130	00:11:19.25	13.63	00:00:05.22
Static Exertion	91	00:13:22.40	16.11	00:00:08.81
Standing Still	160	00:29:51.65	35.96	00:00:11.19
Walking	198	00:26:22.29	31.76	00:00:07.99
Striding	27	00:01:07.06	1.35	00:00:02.48
Sprinting	17	00:00:49.10	0.99	00:00:02.88

Statistics for Scrum Half.

Number of rows: 7

Name	count	total time	%	mean time
Walking	225	00:33:57.70	41.51	00:00:09.05
Jogging	152	00:16:07.65	19.71	00:00:06.36
Standing Still	130	00:29:13.83	35.73	00:00:13.49
Static Exertion	16	00:00:48.36	0.99	00:00:03.02
Striding	17	00:01:00.32	1.23	00:00:03.54
Sprinting	6	00:00:26.52	0.54	00:00:04.42

Statistics for Fly Half.

Number of rows: 7

Name	count	total time	%	mean time

Walking	245	00:37:00.50	43.18	00:00:09.06
Jogging	157	00:12:58.10	15.13	00:00:04.95
Striding	25	00:01:16.85	1.49	00:00:03.07
Static Exertion	33	00:01:50.14	2.14	00:00:03.33
Standing Still	191	00:32:00.74	37.35	00:00:10.05
Sprinting	7	00:00:20.77	0.4	00:00:02.96

Statistics for Centre .

Number of rows: 6

Name	count	total time	%	mean time
Jogging	184	00:15:47.65	19.32	00:00:05.15
Standing Still	223	00:31:25.62	38.43	00:00:08.45
Striding	30	00:01:22.29	1.68	00:00:02.74
Walking	254	00:30:44.45	37.59	00:00:07.26
Static Exertion	23	00:02:01.86	2.48	00:00:05.29
Sprinting	4	00:00:16.42	0.33	00:00:04.10

Statistics for Wing.

Number of rows: 7

Name	count	total time	%	mean time

Standing Still	181	00:32:15.00	39.66	00:00:10.69
Jogging	114	00:08:11.79	10.08	00:00:04.31
Walking	240	00:36:33.23	44.95	00:00:09.13
Static Exertion	21	00:01:57.93	2.42	00:00:05.61
Striding	27	00:01:13.93	1.52	00:00:02.73
Sprinting	10	00:00:42.33	0.87	00:00:04.23

Statistics for Full Back.

Number of rows: 7

Name	count	total time	%	mean time
Walking	243	00:46:14.88	54.45	00:00:11.41
Striding	52	00:03:15.51	3.84	00:00:03.75
Static Exertion	19	00:02:58.50	3.5	00:00:09.39
Standing Still	139	00:19:16.70	22.7	00:00:08.32
Jogging	127	00:10:55.11	12.86	00:00:05.15
Sprinting	20	00:02:00.21	2.36	00:00:06.01