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THE EXPORATION OF RELATIONSHIPS THAT EXIST BETWEEN FACTORS THAT AFFECT AGILITY WITHIN A RUGBY SPECIFIC POPULATION

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ACKNOWLEDGMENTS

I would like to say a big thank you to my dissertation tutor, Rob Meyers. He was there to support me and provide crucial advice when ever it was needed, especially in the days when hand-in was drawing closer. He gave clarity to my thinking and helped to make this process a lot easier than it could have been. I would also like to acknowledge the support and help provided by Dr. Jon Oliver whose previous work and expertise in this area provided the inspiration for my own.

Thanks to all the members of UWIC RFC who participated in the study. Without your help there would be no dissertation!

Last but by no means least I would like to say thank you to all of my family and friends, especially my girlfriend who has had to put up with the last few months, who have seen me through my university years providing support and friendship, without which I would not be where I am today. Thank you for all the memories.

ABSTRACT

The Game of rugby union is a multi-sprint, multidirectional, evasive team game that requires high-speed total body movements often in response to a stimulus. These evasive movements can occur in the form of a side-step, which can therefore be classified as an agility task. Recent research has led to the conclusion that agility is influenced by both change of direction speed (CODS) and cognitive factors, however there is uncertainty in to which factors and their sub-components have the strongest relationships with agility. The purpose of this study is to explore the relationships that exist between agility and its sub-components within a rugby population. In turn this can provide coaches with a better understanding of agility and improve skills such as the side-step.

20 collegiate male rugby players (n = 10 forwards, and n = 10 backs) completed a series of tests including novel planned agility (PA) and reactive agility (RA) tests, a newly designed lateral jump (LJ) test, a Reactive Strength Index (RSI) jump test, and a 10m and 40m maximal straight sprint test. A number of descriptive stats were applied to the raw data including an Analysis of Variance (ANOVA) and Pearson's Product Correlation Coefficient. The findings were then expressed as a common variance (CV).

The findings suggest that CODS and acceleration have the strongest CV with agility (CV's of 56.4% and 59.1% respectively). RSI and therefore the Stretch Shortening Cycle (SSC) were also found to have some form of relationship with agility, the CV of these variables being consistently around or above 50%. This suggests that improved acceleration and therefore improved agility can come from developing an individual's reactive strength. It can safely be suggested that in order to improve agility and therefore skills such as the side-step, it would be necessary to develop both CODS and acceleration through training. This in turn provides coaches with clarity and direction into the necessary ways of improving agility.

CHAPTER I

INTRODUCTION

1.0 Introduction

Many sports such as rugby union require high-speed total body movements, many of these are in response to the motion of a ball, opposition players, or team mates (Young and Farrow, 2006). According to Sheppard and Young (2006), these movements can be classified as agility. There is however, somewhat of a phenomenon surrounding 'agility' and its definitions within the sports science community (Sheppard and Young, 2006). There have been many different definitions and insights into agility such as 'the ability to change direction with minimal loss of control and/or average speed' (Barnes *et al*., 2007), 'a whole-body change in direction' (Baechle, 1994), and also 'the extent to which perception and decision-making influence agility' as first deliberated by Chelladurai (1976), mentioned in Sheppard and Young's (2006) review of agility literature. The latter mentioned definition of agility has been relatively ignored until now. Sheppard and Young (2006) also highlight that the differences in definitions could be due to the variety of academic disciplines from which the investigators base their research.

In light of this inconsistency that has been found in defining agility Sheppard and Young (2006, p. 922) proposed a new definition as "a rapid whole-body movement with change of velocity or direction in response to a stimulus" which is based around the model designed by Young *et al* (2002) shown in Figure 1. It is also stated that for a movement to be considered an 'agility task' it must be an 'open skill'. This occurs when a movement is not pre-planned or rehearsed and is in reaction to a stimulus (Young *et al*, 2002). This new definition of agility aims to cover all of the components, psychological, biomechanical and physiological that influence agility as a whole making it an interdisciplinary attribute.

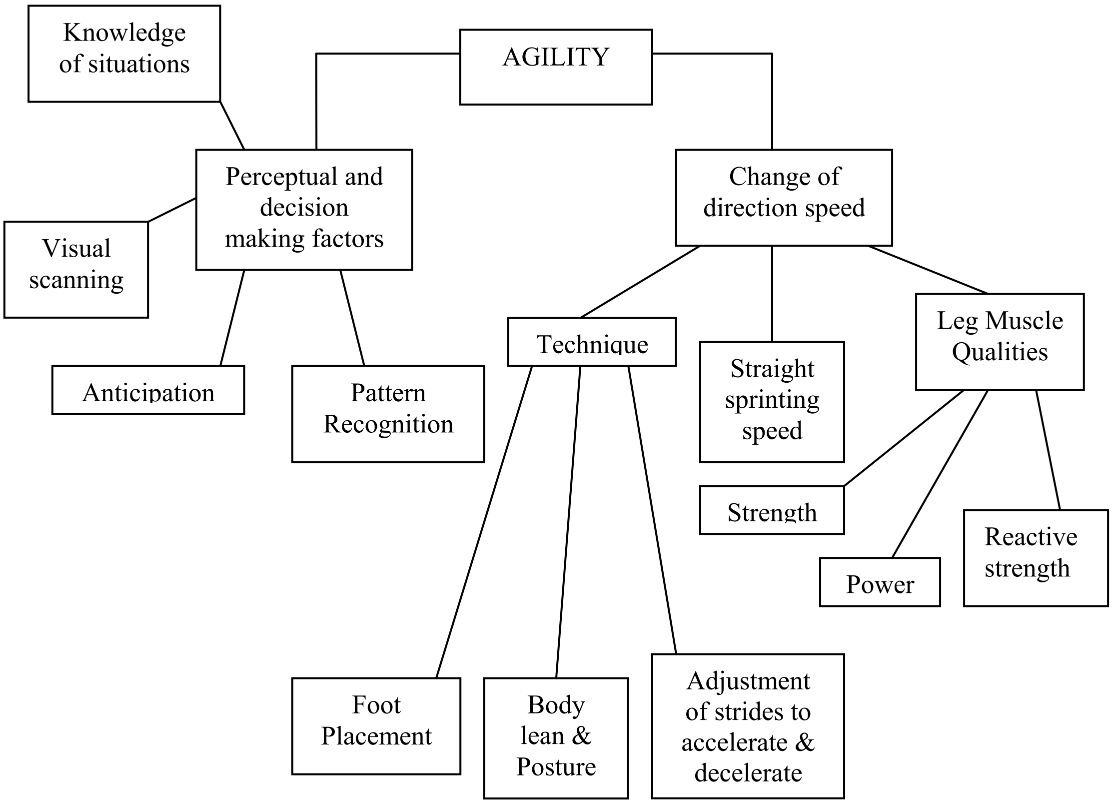


Figure 1. Model indicating the main factors determining agility (adapted from Young *et al*., 2002)

Research conducted by Young *et al.* (2002), led them to comprehensively outline agility and its influencing factors associated with muscle power and running speed with changes of direction. They outlined the multi-faceted influences involved in agility performance and identified two main components, "change of direction speed" (CODS) and "perceptual and decision making factors" (p.284). As shown by the model in Figure 1 by Young *et al.* (2002), CODS is a sub-component of agility that requires no stimulus (i.e. sprints with a change of direction - COD) as opposed to sprints that could include a COD in response to a stimulus. The variables associated with influencing this COD in response to a stimulus are included in perceptual and decision making factors. This means that in order to investigate agility thoroughly both components and their sub-components need to be assessed together. The extent to which each component influences agility is still unknown.

The Game of rugby union is a multi-sprint, multidirectional sport, interspersed with high intensity activities such as rucking, mauling, side-stepping, and lifting (Pearson, 2001). It is an evasive team game that requires a wide range of playing skills and various forms of physical fitness (Hazeldine and McNab, 1998), agility being only one of these components as shown in Figure 2. A player who possesses high levels of agility is elusive, has tremendous foot co-ordination and is difficult to tackle and is therefore an important weapon in the attacking armoury of any team (Kear, 1996). One element of agility that can be seen on a rugby pitch that is regularly used in tackle evasion is described by Kear (1996) as the side-step. This is a sudden, quick change of direction by an immediate straightening up. Sayers and Washington-King (2005), show that the lateral side-step is a common evasive skill that is used in elite rugby. The side-step can be described as an ‘open skill’ as it is often used in response to a stimulus provided by a defender in order to evade being tackled. This skill therefore fits into Sheppard and Young’s (2006) definition of agility.

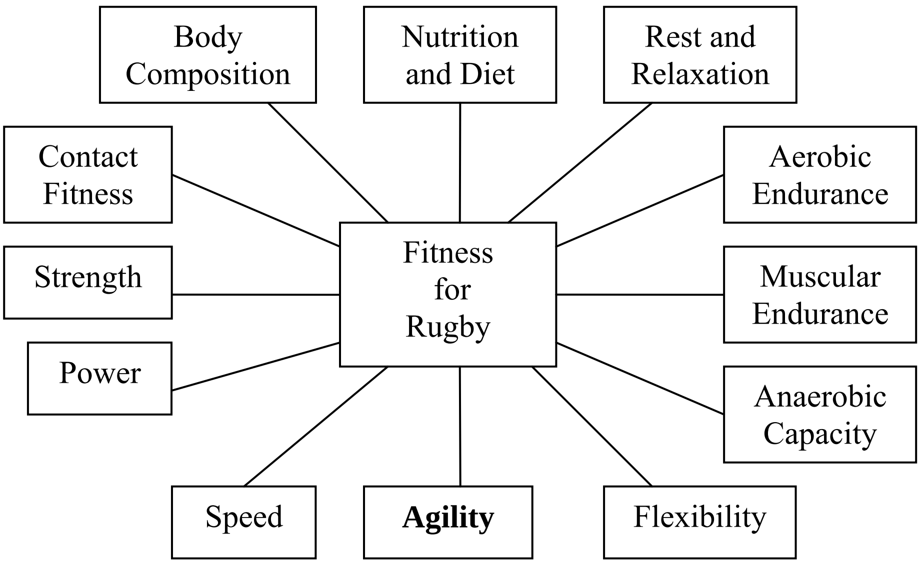


Figure 2. Model of physical fitness for rugby (adapted from Hazeldine and McNab, 1998)

Pearson (2001) states that agility should not be taken for granted and can actually be taught to individual players. This will develop both their attacking and defensive skills. Developing agility benefits a player in many ways such as increasing their fine muscle control allowing individual's to optimise their body alignment as to prevent injury and maximise force exertion during the execution of skills such as the side-step (Pearson, 2001). The best way to train agility however seems to be elusive (Young and Farrow, 2006) especially compared to the other components included in Figure 2 such as speed or power. If it were possible to identify the relative importance of the various contributing factors to agility it would therefore make it easier to develop training strategies to maximise the development of agility and specific skills that involve agility such as the side-step.

1.1 Aim of the Study:

The aim of this study therefore, is to explore any relationships that are found to lie between the variables outlined by Young *et al.* (2002) in Figure 1. Agility will be measured using a rugby related side-step within a rugby specific population. Any relationships that are found within this study could therefore provide coaches with a better understanding of agility as a whole and also lead them to improve rugby related skills such as the side-step through the specific training of certain variables.

CHAPTER III

METHODOLOGY

3.0 Methodology

3.1 Pilot Testing

Prior to the data collection of the main research study, it was necessary to determine the exact dimensions of the new tests being used and also the protocol for all tests by conducting a pilot study. This allowed the researcher a familiarisation period with the testing equipment and also the fine tuning of the protocol.

3.2 Sample Population

The sample for this study was selected from the University of Wales Institute, Cardiff (UWIC) rugby union squad. The twenty male students (n=10 forwards, n=10 backs) were part of the 'Rugby Excellence Squad' (elite members of the UWIC RFC Squad) that train on a full time basis. UWIC RFC compete in Division one of the Welsh Asda League's and also in the Premier South Division of the British University Sports Association (BUSA).

3.3 Protocol

All testing was completed in the National Indoor Athletics Centre (NIAC). All subjects completed an informed consent form and perceived activity readiness questionnaire (PAR-Q) before taking part in any testing (see Appendices 1 and 2). This ensured that subjects were healthy and fit enough to partake in the testing and detailed the purpose of the research, testing procedures and what was entailed, the possible risks involved and also ensured anonymity throughout. All subjects were required to wear appropriate clothing and footwear to participate in the testing. Each subject conducted a warm-up followed by each of the following individual tests, a Straight Sprint, Planned Agility, Reactive Agility, Rebound Jump and a Lateral Jump test in a random order within the same day.

3.3.1 Warm-up

All subjects completed a warm up that included a 200m jog around the indoor track in NIAC followed by a series of 3-5 short sprints and jumps (laterally and vertically), and dynamic stretches. This warm up was repeated if there were any delays between tests.

3.3.2 Height and Weight

Height and weight were measured prior to the beginning of the warm-up. Height was measured using a Leicester Height Measurer (SECA: Hamburg, Germany) which is accurate to the nearest 0.01cm. Subjects were required to remove footwear, stand straight with their feet together. Subjects were asked to breath in, stretch up, breath out, and a measurement was then taken.

Weight was measured using SECA digital scales (Model 770: Hamburg, Germany) which are accurate to the nearest 0.1kg. Subjects were asked to remove all clothing apart from their shorts and step onto the scales. After 3 Seconds the reading shown on the scales was taken and noted down.

3.3.3 Straight Sprint Test

Using the Smartspeed Timing Gate System (Fusionsport, Brisbane, Australia) 10m and 40m straight sprint times were gathered. The Smartspeed system has been found to be reliable with a standard error of < 0.03s over 5, 10 and 20m distances (D'Auria et al., 2006). The testing system was set up as shown in Figure 3 over three lanes. Gates were accurately placed at the start line, 10m interval and finish line (40m) in both lanes using a measuring tape.

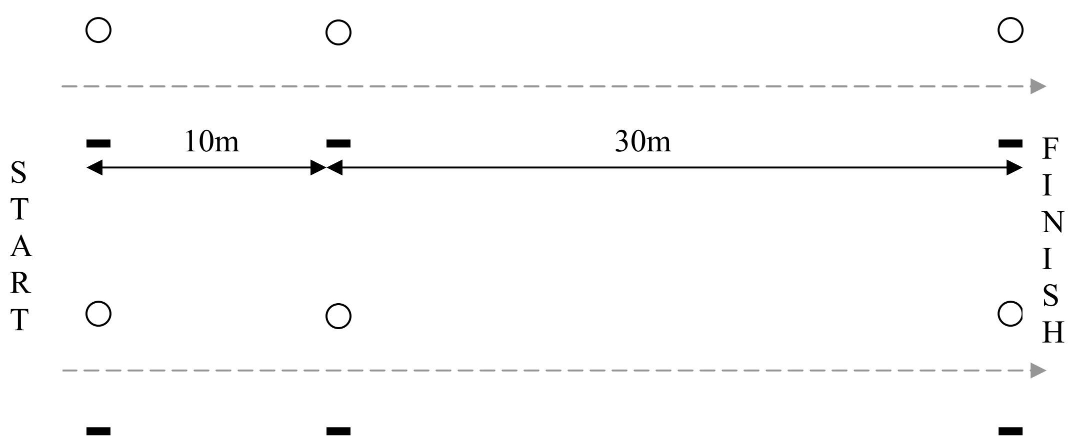


Figure 3. Straight sprint test set-up

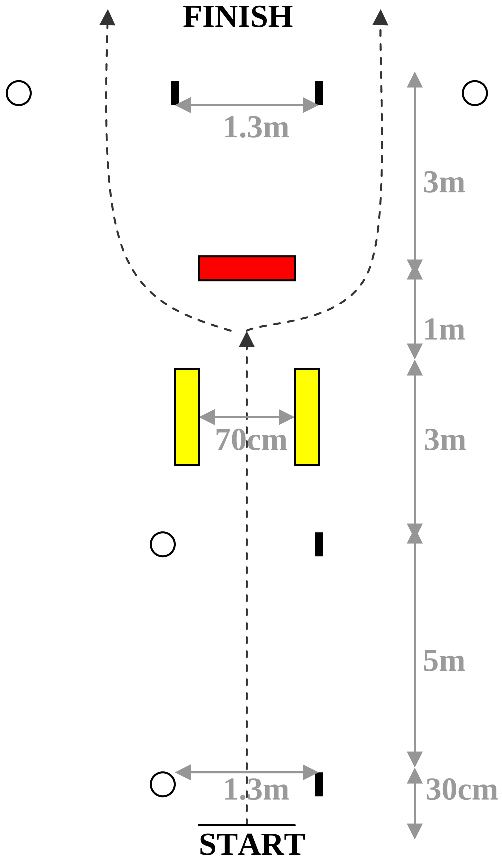
Subjects were timed in pairs with someone who was deemed to be competitive over this distance as to incorporate an element of competition and gain maximal efforts. In preparation, subjects stood 30cm back from the start line (marked by tape) as not to break the beam and start the timing before they sprinted. When the subjects were ready, they were told to take up a standing sprint start position behind the start line, on the starter's instruction they maximally sprinted 40m. Reaction time therefore did not affect the results as the timing started when the subject broke the sensor beam by running through it, not on the starters command. No practice runs were deemed necessary to familiarise subjects with this test due to its simplicity. Subjects performed three recorded maximal trials.

3.3.4 Agility Testing

A new test for both planned agility (PA) and reactive agility (RA) was designed for this investigation. The test was designed based around the resources available to the researcher and the protocols used in previous research from Besier *et al.* (2001), Farrow *et al*. (2005), Sheppard *et al*. (2006) and also new research that is yet to be published by Oliver (2008). This unpublished research looked into the reliability and relationships of 10m straight sprints (SS), PA and RA. The testing protocol used in this study is primarily based on the work of Oliver (2008) where the agility tests used very similar protocol. Barriers were used to prevent subjects from cutting corners and lights were used as a stimulus for RA testing. Reliability was expressed using the Coefficient of Variation, this was found to be < 4% for all relationships including means of cuts both left and right. All relationships between PA, RA and SS were found to have an r-value of $r > 0.9$ ($p < 0.001$) which shows a very strong correlation between the variables and that this was not a chance occurrence. The similarities in test protocols between the SS test and agility tests are the reason for the innovative findings of Oliver (2008) suggesting that SS and agility do relate to one another. This has formed the fundamentals of the new testing protocols of PA and RA within this study.

As with the testing in Oliver's (2008) research, the new tests for this research study were designed so that PA and RA were measured within the same dimensions (i.e. the same test set-up), the only difference between the tests was the presence of a stimulus within the reactive test.

The Smartspeed System was used to measure the times in the RA and PA tests and was set up as shown in Figure 4.



= Timing Gates (= receptor, = reflector)

= Simulated Opponent = Barrier = Start Line (tape)

Figure 4. Agility Test set-up

The red obstacle ahead of the subject simulated an opponent that the subject had to avoid using a side-step motion either left or right. The first split time was taken over an initial 5m up to the second timing gate, and the second split time was taken over 7m up to the third set of gates (either left of right). The only difference between the PA and RA tests was that in the RA test, as the subject passed through the second timing gate (5m) either the left or right gate flashed, indicating the direction in which the subject should step. The flashing represents a gap or a stimulus that has developed, indicating the direction in which to avoid the opposition. A foam barrier (Dimensions: 70cm high, 90cm wide, 30cm deep at base) was used to represent the simulated opponent and it was placed 4m back from the second gate as to give the subject enough time so that they could react and maintain speed throughout the test whilst still under pressure to perform and react correctly. This distance was decided upon after pilot testing. A shorter distance showed that subjects weren't completing the test maximally as they couldn't react in time to the stimulus. 4m was found to provide enough time and space in order for subjects to react maximally whilst still being under pressure within a safe, game realistic environment.

Whilst in the process of pilot testing it was also found that during the RA test the correct side-step movement was used due to the reactive aspect and therefore pressures of the test. During the PA test however, subjects used a swerving motion to avoid the simulated opponent. To isolate this side-step motion, another two foam barriers were placed 70cm apart with the outer edges in line with the edge of the running lane (1.3m) and 1m away from the simulated defender (as shown in Figure 4). This prevented a swerving technique and promoted the use of the side-step motion to avoid the obstacle safely within the 1m gap.

3.3.5 Planned Agility Test

CODS was assessed (PA) using the set-up shown in Figure 4. The flashing lights were disabled for this test. The subject was given a pre planned route and was told to step to either the left or right when avoiding the simulated defender. Each subject was given one practice trial in each direction to familiarise themselves with the test set-up and performed three recorded trials in each direction. As in the straight sprinting tests, the subjects stood 30cm back from the start line (marked by tape) as not to break the beam and start the timing before they began. The subjects were asked to complete the tests with maximum exertion and start from a standing sprint start position when they were ready. A walk back recovery was considered adequate recovery between trials. A trail was deemed void if the subject made substantial contact with any of the foam barriers.

3.3.6 Reactive Agility Test

The RA and cognitive factors were measured using the same set up as in Figure 4. The Smartspeed System was set to randomly indicate the direction in which the individual needs to side-step after the second gate was broken (on average 0.04s; Oliver, 2008) by flashing. Subjects were given one random practice trail and then completed four recorded random trials. To ensure that maximal effort was exerted by subjects in this test, they were told that the initial 5m split time recorded in the PA test was to be compared to the 5m split time of that in the RA test. The subject was also told that they must react to the stimulus and not attempt to predict the direction of it. A trail was deemed void if the subject made substantial contact with any of the foam barriers or went the wrong way during the RA test.

3.3.7 RSI Jump Test

The Reactive Strength Index (RSI) jump test was used to generate RSI of five consecutive stiff legged jumps. This was measured again using the Smartspeed Timing System in conjunction with a SmartJump Contact Mat (Fusionsport, Brisbane, Australia). The jump mat was linked to one Smartspeed receptor and the jumping programme was used. It was explained to the subject that in order for the test to be valid the subject must have their hands on their hips throughout the test as not to generate momentum with their arms, and to land on the mat after each jump. After entering the subject's weight and changing the programme to measure the contact time for five consecutive jumps, the subject was asked to step onto the mat. Once the system was set the subject was asked to perform one maximal squat jump followed by four consecutive stiff legged jumps as high, and as fast as they could, without letting their heels touch the floor. Each subject had one familiarisation trial and then performed three recorded trials with at least 2 minutes rest between trials.

3.3.8 Lateral Jump Test

To asses explosive power, individual leg strength and any imbalances between left and right legs in relation to a side-step movement within the horizontal plane, a lateral jump (LJ) test was designed. A 90^{o} single leg jump is a similar movement to the movement replicated when making a side-step.

Using a levelled sandpit, cones were laid out at a 90^o angle with the measuring tape running parallel. The subject was asked to stand side on (90^o) to the sand pit facing forwards with the foot of their jumping leg level with the beginning of the measuring tape. They were then asked perform a maximal single leg jump sideways off their jumping leg in line with the cones at a 90^o angel and land on their opposite leg. As in the RSI jump test, it was explained to the subject that in order for the test to be valid the subject must have their hands on their hips throughout the test as not to generate momentum with their arms and gain an unfair advantage. The sand was dampened so that when the subject landed a definite mark was made in the sand. The measurement was taken as the distance between the inside of the take off foot to the inside of the landing foot. This was visually observed and noted down by the researcher. The sand was racked flat after each jump. Subjects were permitted one practice jump off each leg after a demonstration by the researcher. Six maximal jumps were then recorded (three off each leg), alternating between legs.

3.4 Statistical Analysis

A number of descriptive stats were applied to the raw data in order to give meaning the results and find any relationships that were related to the aim of the study. All statistical analyses were performed using the Minitab 14.0 package and Microsoft Excel.

A One-way ANOVA was used to determine the differences between the means of each variable between backs and forwards. The means were considered to be significantly different if the P-Value was ≤ 0.05. Pearson's Product Correlation Coefficient was then used to asses the extent of relationship's between variables, specifically each variable and RA (RA is considered to be the true score of agility). Each variable was then correlated against all other variables. A relationship was considered to be significant if the P-Value was ≤ 0.05. The Coefficient of Determination (r^2-value) was then calculated by squaring the r-value also given from Pearson's Product Correlation Coefficient. To generate a common variance (CV) score in order show the relationship between variables as a percentage, the Coefficient of Determination was multiplied by 100. Thomas and Nelson (1996), state that the CV can be accepted if it is found to be ≥ 50%.

CHAPTER IV

RESULTS

4.0 Results

Table 1. The mean and standard deviations of the test variables within the whole group and back's and forward's groups independently

	Group (n=20)		Backs (n=10)		Forwards (n=10)	
Variable	**Mean**	**SD ±**	**Mean**	**SD ±**	**Mean**	**SD ±**
Weight (kg)	100.12	17.38	87.70*	5.13	112.54*	16.38
Height (cm)	185.34	6.29	182.19*	5.32	188.48*	5.48
RSI Average	1.22	0.31	1.40*	0.31	1.03*	0.14
RSI Max	1.43	0.38	1.67*	0.35	1.19*	0.19
Lat Jump (cm)						
Left Leg	189.25	9.28	189.00	8.79	189.50	9.80
Right Leg	189.70	6.21	186.80*	5.42	192.60*	5.48
Mean	189.48	6.60	187.90	6.79	191.05	5.93
PA (s)						
Left	2.45	0.14	2.38*	0.09	2.52*	0.14
Right	2.44	0.17	2.37	0.12	2.51	0.17
Mean	2.44	0.15	2.37*	0.10	2.52*	0.15
10m (s)	1.77	0.12	1.72*	0.09	1.83*	0.12
40m (s)	5.42	0.29	5.25*	0.24	5.58*	0.23
RA (s)	2.64	0.14	2.58*	0.11	2.71*	0.12

***** P-Value ≤ 0.05 (ANOVA) between backs and forwards

Table 2. The r-values and the Common Variances of correlations between all variables and RA

	Group (n=20)		Backs (n=10)		Forwards (n=10)	
Variable vs RA	**r - value**	**CV (%)**	**r - value**	**CV (%)**	**r - value**	**CV (%)**
Weight (kg)	0.587*	35.5*	0.027	0.1	0.513	26.3
Height (cm)	0.308	9.5	0.126	1.6	-0.013	0.01
RSI Average	-0.664*	44.1*	-0.508	25.8	-0.652*	43.5*
RSI Max	-0.649*	42.1*	-0.651*	42.4*	-0.387	5
LJ (cm)						
Left Leg	-0.519*	26.9*	-0.661*	43.7*	-0.590	34.8
Right Leg	0.147	2.2	-0.410	16.8	0.144	2.1
Mean	-0.296	8.8	-0.591	34.9	-0.421	17.7
PA (s)						
Left	0.792*	62.7*	0.484	23.4	0.884*	78.1*
Right	0.679*	46.1*	0.348	12.1	0.773*	59.8*
Mean	0.751*	56.4*	0.414	17.1	0.855*	73.1*
10m (s)	0.769*	59.1*	-0.648*	43*	0.730*	53.3*
40m (s)	0.685*	46.9*	0.502	25.2	0.602	36.2

* P-Value ≤ 0.05 (Pearson's Product Correlation Coefficient)

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Table 3. The Common Variance (%) for the whole group's variable scores correlated against one another

		Weight (kg)	Height(cm)	RSI Average	RSI Max	LJ (cm)			PA (s)			10m(s)	40m(s)	RA(s)
						Left	Right	Mean	Left	Right	Mean			
Weight (kg)														
Height (cm)		26.4*												
RSI Average		39.5*	13											
RSI Max		44.9*	15.5	81.7*										
LJ(cm)	Left Leg	6.4	1	13.1	17									
	Right Leg	9.4	10.7	3.2	0.7	18.4								
	Mean	0.1	0.7	2.9	6.4	81.9*	59.6*							
PA(s)	Left	52.6*	14.7	54*	45.6*	23.8*	0.9	9						
	Right	30*	2.3	40*	30.6*	14.3	1.3	10.2	77.4*					
	Mean	42*	6.8	47.1*	39.3*	19.7*	0.1	10.6	92.7*	95.2*				
10m (s)		26.6*	4.5	46*	34*	24.4*	2.2	6.9	61.9*	48.3*	57.8*			
40m (s)		36.7*	3.5	46.9*	40.8*	15.6	0.8	5.6	60*	56.3*	62.6*	81.5*		
RA (s)		34.5*	9.5	44.1*	42.1*	26.9*	2.2	8.8	62.7*	46.1*	56.4*	59.1*	46.9*	

* P-Value ≤ 0.05 (Pearson's Product Correlation Coefficient)

Table 4. The Common Variance (%) for all variables relevant to back's scores correlated against one another

		Weight(kg)	**Height(cm)**	**RSI Average**	**RSI Max**	**LJ (cm)** Left	Right	Mean	**PA (s)** Left	Right	Mean	**10m(s)**	**40m(s)**	**RA(s)**
Weight (kg)														
Height (cm)		0												
RSI Average		9.4	0.4											
RSI Max		0.9	1.1	82.3*										
LJ (cm)	Left Leg	3.7	0.1	22.8	33.4									
	Right Leg	8.2	13.4	10.7	18.4	67.1*								
	Mean	5.7%	1.7	19.4	29.7	94.7*	86.3*							
PA (s)	Left	4.3	0.9	53.7*	57.6*	29.3	33.5	33.8						
	Right	11.2	21.7	34.8	33.2	13.7	29.2	20.7	70.6*					
	Mean	8.9	11.6	45.4*	45.2*	21	33.9	27.9	85.8*	94.9*				
10m (s)		5.8	9.3	57.9*	62.1*	47.6*	58.2*	56.4*	55.7*	52.3*	57.8*			
40m (s)		0.1	34.6	34.9	35.6	32.9	55.7*	44.8*	45.2*	72.5*	66.5*	74.8*		
RA (s)		0.01	1.6	25.8	42.3*	43.6*	16.8	34.9	23.4	12.1	17.3	42*	25.2	

* P-Value ≤ 0.05 (Pearson's Product Correlation Coefficient)

Table 5. The Common Variance (%) for all variables relevant to forward's scores correlated against one another

		Weight(kg)	**Height(cm)**	**RSI Average**	**RSI Max**	**LJ (cm)**			**PA (s)**			**10m(s)**	**40m(s)**	**RA(s)**
						Left	Right	Mean	Left	Right	Mean			
Weight (kg)														
Height (cm)		12.3												
RSI Average		42.6*	15.8											
RSI Max		60.8*	0.4	31.5										
LJ (cm)	Left Leg	42.1*	5.6	37.9	42.8*									
	Right Leg	4.4	2.8	3.4	6.6	1.8								
	Mean	40.1*	7.5	18	43*	79*	32.8							
PA (s)	Left	59.4*	10.8	56.6*	15.4	40.6*	0.04	26.8						
	Right	32	3.6	21.5	4.7	23.6	10.4	30.4	73.6*					
	Mean	47.1*	6.9	37.7	9.5	33.9	3.3	31.9	91.4*	94.3*				
10m (s)		10.8	2.4	12.4	1.6	21.4	18	3.4	49.4*	29.5	41.1*			
40m (s)		33.9	10	15	0.3	19.6	7.6	5.7	54.6*	30	43.7*	81.2*		
RA (s)		26.3	0.01	42.5*	5	34.8	2.1	17.7	78.1*	59.8*	73.1*	53.3*	36.2	

* P-Value ≤ 0.05 (Pearson's Product Correlation Coefficient)

Table 1 show's that significant differences exist between backs and forwards within all variables with the exception of LJ left, LJ mean and PA right. From Tables 2, 3, 4 and 5 it can be seen that the strongest CV's that relate to the aim of the study lie between PA, 10m time and RA within the whole group. Significant CV's are also shown to exist between 10m and RA within the backs and forwards groups individually, however the acceptance of these CV's differs (Backs < 50% and Forwards > 50%). Although there is a CV less than 50%, RSI average has a similar significant relationship with PA mean, 10m time and RA within the whole group with a CV > 40% in each case. CV's between RSI with PA mean and 10m in the forwards and RA in the backs, have however been found to be non significant.

All relevant relationships relating to the main findings of the study are displayed in Figures 5 through to 12 to illustrate their significance, correlation, CV and also show the differences in relationships between the back and forward groups.

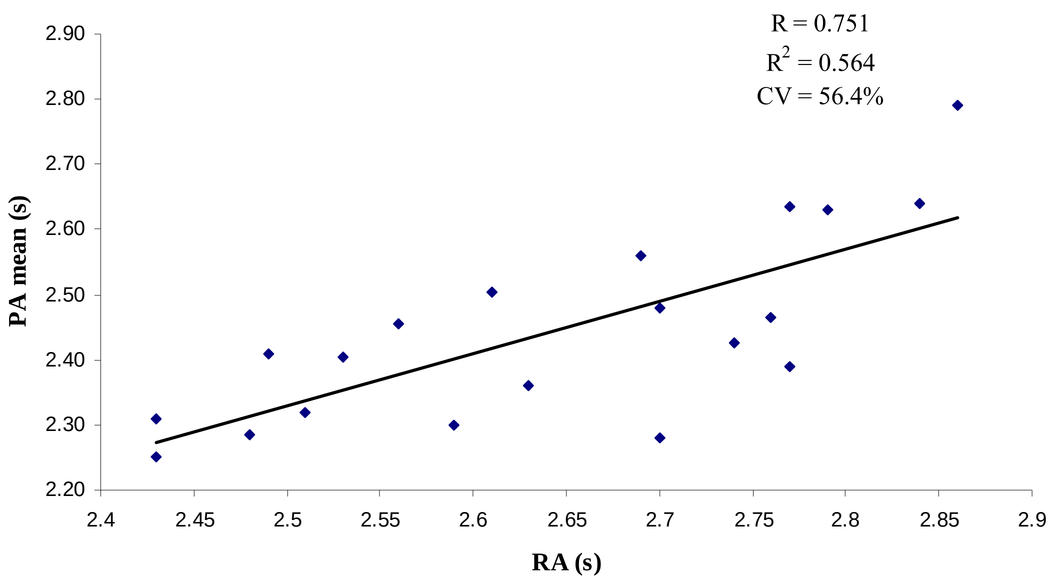

Figure 5. Correlation of PA mean and RA within the whole group

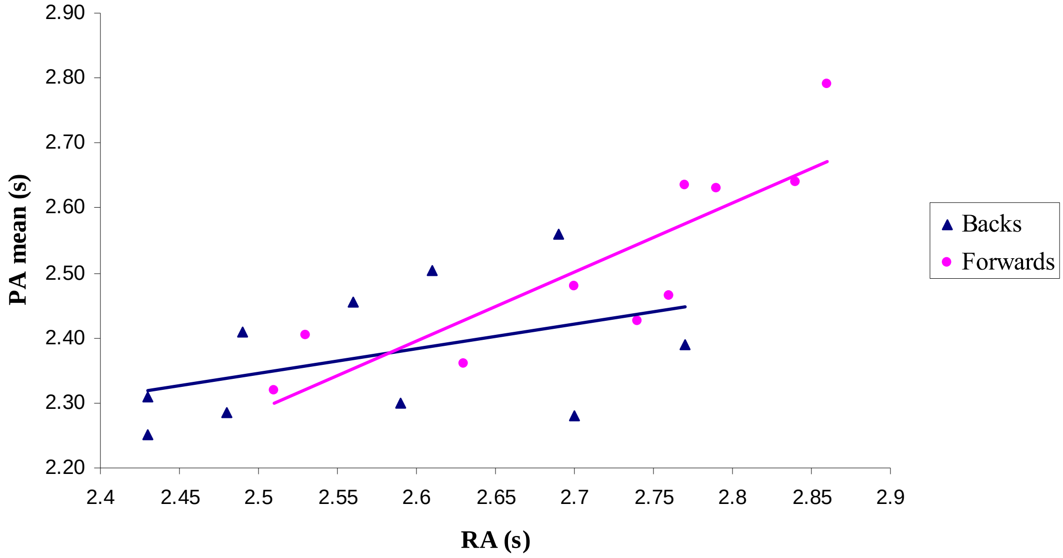

Figure 6. Correlation of PA mean and RA within the whole group showing backs and forwards individually

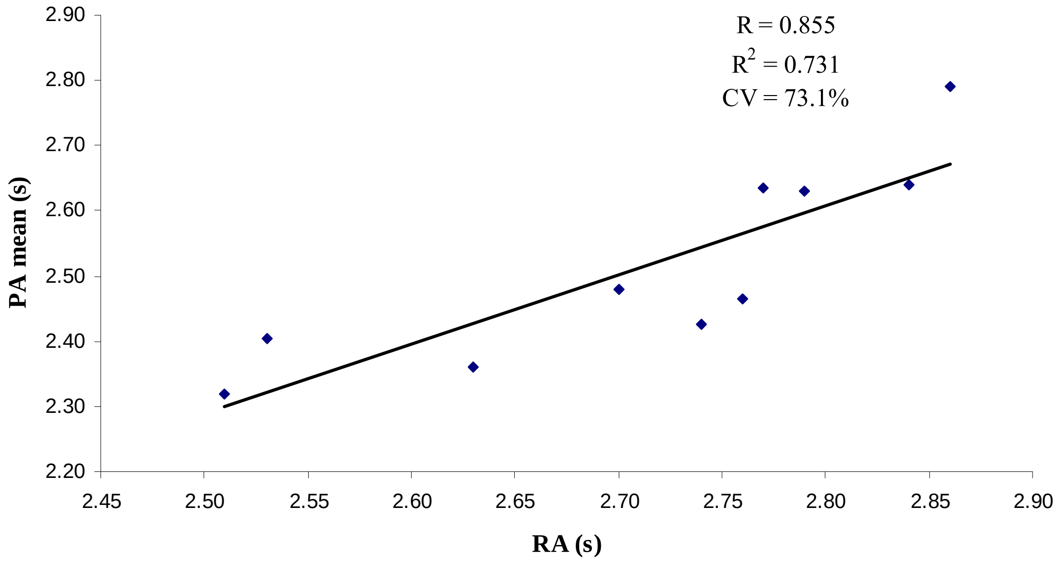

Figure 7. Correlation of PA mean and RA within the forwards

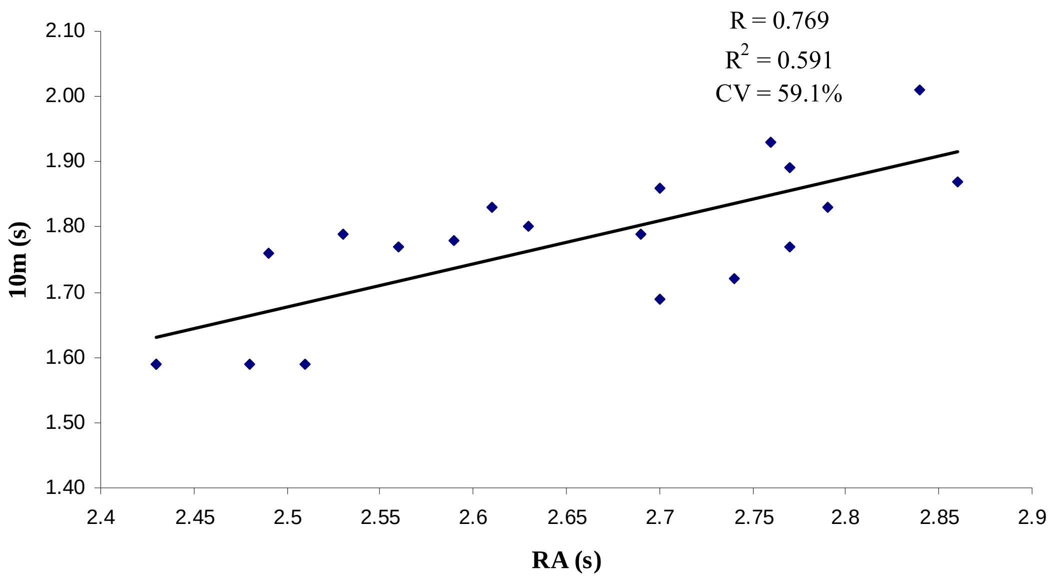

Figure 8. Correlation of 10m time and RA within the whole group

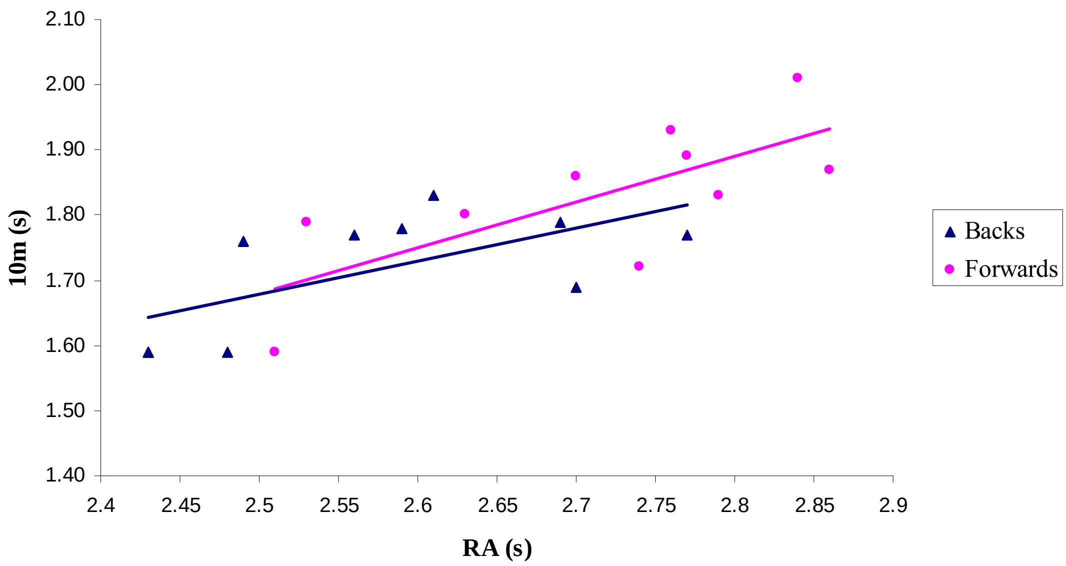

Figure 9. Correlation of 10m and RA within the whole group showing backs and forwards individually

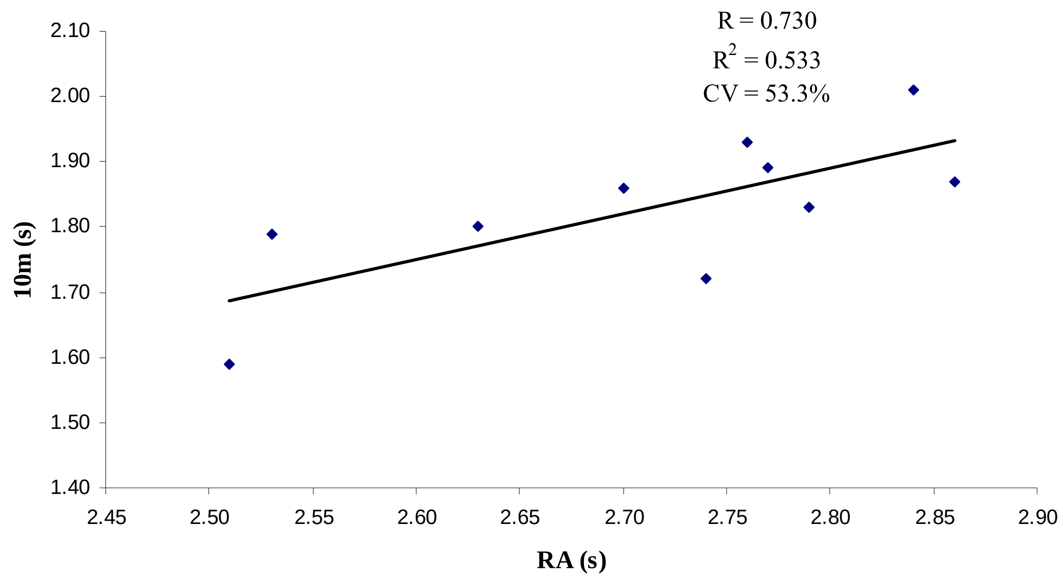

Figure 10. Correlation of 10m and RA within the forwards

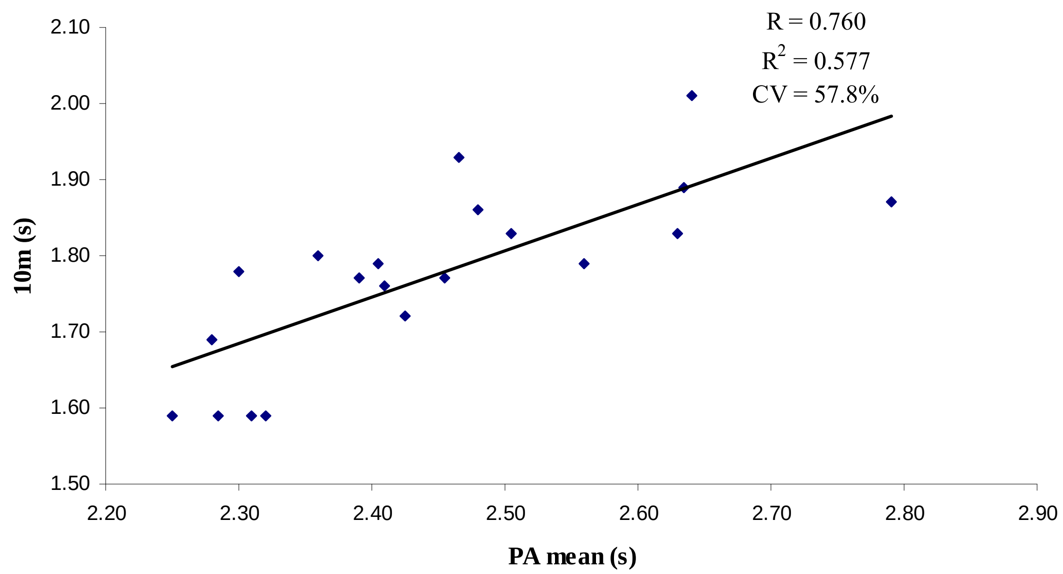

Figure 11. Correlation of 10m and PA mean within the whole group

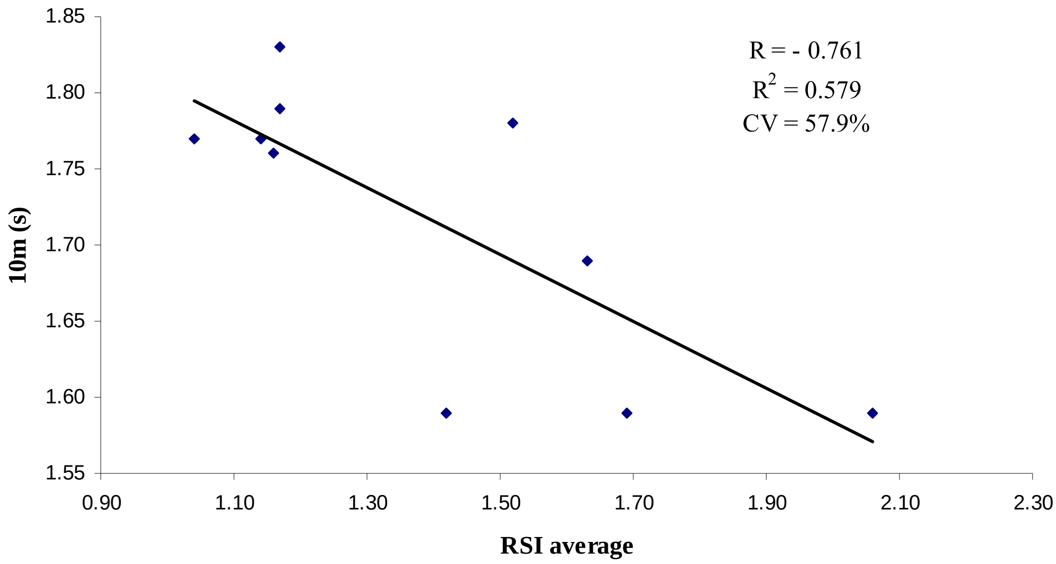

Figure 12. Correlation of 10m and RSI average within the backs

CHAPTER VI

CONCLUSION

6.0 Conclusion

Based on the findings of this study it can be suggested that CODS and acceleration have the strongest relationships with agility. Although the extents to which these variables influence agility cannot be identified from this research, it can safely be suggested that in order to improve agility and therefore skills such as the side-step, it would be necessary to develop both CODS and acceleration through training. This in turn provides coaches with clarity and direction into the necessary ways of improving agility. The techniques that should be used in order to train these variables cannot be determined from this research. It was found however that a relationship exists between acceleration and RSI. This suggests that improved acceleration and therefore improved agility can come from developing an individual's reactive strength (i.e. power).

The current research suggests that forwards and backs rely on different variables (shown in Figure 1) when performing agile movements such as the side-step, however all elements of Young *et al.*'s (2002) model should be addressed when aiming to improve agility as a whole within a rugby population. Training techniques employed by coaches should therefore include drills that improve both the physiological and psychological variables associated with agility although there should be a greater emphasis on training acceleration, CODS and reactive strength. This will aid all players, regardless of playing position, in the effective development of their agility and therefore improve skills such as the side-step.

6.1 Further Recommendations:

Areas surrounding the findings of this current study that require further research should include identifying the best training techniques for developing these variables shown to affect agility. This could further refine the drills and training techniques that are relevant to developing each aspect of agility and gaining a greater ability to perform agility tasks like the side-step. Further research could also show the extent to which each variable impacts upon agility through the use of stepwise regression. This could further enable training to become more specific in developing agility tasks such as the side-step within rugby players due to the coaches greater understanding of which variables influence agility the most. Increasing the subject numbers within future studies will increase the power of any findings that may support the findings of this study or generate alternative conclusions. Reliability studies should be conducted to verify the use the tests used within this study so that the findings and any future research surrounding this study can be built upon. Testing should also become more specific to the game of rugby via the use of a more sports-specific stimulus within the testing protocol. Future findings can then be better applied to the game and the whole outcome of the research will therefore become more successful in improving agility.

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APPENDICES

Appendix 1. Informed Consent form.

Dear Subject,

I am a Level 3 undergraduate/postgraduate student in the School of Sport, PE, & Recreation, at the University of Wales Institute Cardiff. The title of my dissertation is "The exploration of relationships that exist between factors that affect agility within a rugby specific population", and I wonder if you would be kind enough to help with my research.

The research aims to discover any relationships that exist between the variables associated with influencing agility, these being change of direction speed and cognitive factors. As a subject, you will be asked to perform a number of tests involving a series of maximal jumps, maximal sprints and some change of direction tests, some in response to a stimulus in relation to a lateral side-step. The research may prove beneficial you as individual for personal reference. It is also a relatively new area of research and may provide coaches with a better understanding of which physical attributes influence agility. This could therefore develop agility training in specific agile movements such as the side-step so that it can be applied in game specific situations.

There are no risks involved in the study, but in the event of an accident the appropriate services will be contacted immediately as your safety is paramount.

Participation is entirely voluntary. You are free to withdraw at any stage of the research process.

Confidentiality will be upheld as far as humanly possible. The results of your completed tests will be kept strictly confidential in accordance with the provisions of the Data Protection Act (1998). Only the principle investigator and supervisors will have access to the information. Your name or any such identifiable data will not appear in any academic papers resulting from the research.

I would like to express my deep appreciation for your assistance in this investigation. Your part in this research would be significant and influential. If you are willing to participate, please read the slip overleaf carefully, and sign. If you have any queries, please do not hesitate to contact me.

Thank you. I look forward to hearing from you.

Yours sincerely,

R. Crane

…………………………………………………

I have read and fully understood the request to be a subject in the research of Mr. R. Crane. I understand what I have to do. I understand the risks involved, and the measures in place in the event of an accident. I understand that participation is entirely voluntary, and that withdrawal is possible at any time. I understand the measures that will be taken to uphold confidentiality as far as possible.

I agree to participate.

Signature…………………………………………….. *Date*……………………

Appendix 2. PAR-Q form

Physical Activity Readiness Questionnaire (PAR-Q)

Name: ……………………………………..

Please circle the following questions appropriately:

1. Has your doctor ever said you have heart trouble? Yes / No

2. Do you frequently suffer from pains in the chest? Yes / No

3. Do you often feel faint or have spells of severe dizziness? Yes / No

4. Has a doctor ever said you blood pressure was too high? Yes / No

5. Has your doctor ever said that you have a bone or joint Problem such as arthritis that has been aggravated by Exercise, or might be made worse with exercise? Yes / No

6. Have you acquired any ligament damage to your lower Limbs that may become injured or aggravated by jumping exercise?

7. Is there a good physical reason not mentioned here why you Should not take part in a fitness test? Yes / No

8. Are you **un**accustomed to vigorous exercise? Yes / No

If you have answered yes to any of these questions listed above, please add detail below. Similarly, if there are any situations which will prevent you from exercising write them here (or let us know if they arise throughout the testing)

If your situation changes regarding your responses to these questions, please notify the test administrator.

Signed …………………………………

Date …………………………………

Appendix 3. Raw Data Table

Subject Number	Weight (kg)	Height (cm)	RSI average	Max RSI	Lat Jump (cm) Left Leg	Right Leg	Mean	PA (s) Left	Right	Mean	10m (s)	40m (s)	RA Time (s)	Direction (R/L)
Backs														
1	80.2	183.1	2.06	2.27	204	192	198	2.29	2.33	2.31	1.59	5.07	2.43	R
2	92.9	185.8	1.16	1.4	193	186	189.5	2.46	2.36	2.41	1.76	5.14	2.49	L
3	85.7	178.4	1.69	2.01	195	189	192	2.32	2.25	2.29	1.59	5.05	2.48	L
4	94.5	185.3	1.42	1.95	200	198	199	2.27	2.23	2.25	1.59	4.85	2.43	R
5	82	183.2	1.17	1.27	179	182	180.5	2.54	2.58	2.56	1.79	5.43	2.69	R
6	90	178.4	1.52	1.67	181	180	180.5	2.3	2.3	2.30	1.78	5.36	2.59	R
7	90.2	186.1	1.04	1.13	190	191	190.5	2.4	2.38	2.39	1.77	5.36	2.77	L
8	89.4	189.5	1.63	1.91	181	186	183.5	2.35	2.21	2.28	1.69	5.02	2.7	R
9	81	182.6	1.14	1.42	177	181	179	2.45	2.46	2.46	1.77	5.52	2.56	L
10	91.1	169.5	1.17	1.69	190	183	186.5	2.45	2.56	2.51	1.83	5.66	2.61	L
MEAN	**87.70**	**182.19**	**1.40**	**1.67**	**189.00**	**186.80**	**187.90**	**2.38**	**2.37**	**2.37**	**1.72**	**5.25**	**2.58**	
SD	**5.13**	**5.32**	**0.31**	**0.35**	**8.79**	**5.42**	**6.79**	**0.09**	**0.12**	**0.10**	**0.09**	**0.24**	**0.11**	
Forwards														
11	108	183.5	1.17	1.32	188	186	187	2.55	2.72	2.64	1.89	5.7	2.77	L
12	118.2	181	1.13	1.18	199	197	198	2.5	2.46	2.48	1.86	5.71	2.70	R
13	119.8	186.5	0.92	0.99	172	199	185.5	2.54	2.39	2.47	1.93	5.74	2.76	L
14	112.4	187.4	1.02	1.09	181	189	185	2.59	2.67	2.63	1.83	5.43	2.79	L
15	97.4	187.3	1.05	1.15	199	190	194.5	2.31	2.33	2.32	1.59	5.16	2.51	R
16	115	198.1	1.18	1.25	191	187	189	2.42	2.39	2.41	1.79	5.64	2.53	R
17	151.2	195	0.75	0.85	179	190	184.5	2.81	2.77	2.79	1.87	5.83	2.86	L
18	105.4	194.3	0.89	1.47	191	199	195	2.65	2.63	2.64	2.01	5.85	2.84	R
19	108	185.5	1.04	1.19	192	189	190.5	2.45	2.4	2.43	1.72	5.33	2.74	R
20	90	186.2	1.16	1.42	203	200	201.5	2.4	2.32	2.36	1.8	5.45	2.63	L
MEAN	**112.54**	**188.48**	**1.03**	**1.19**	**189.50**	**192.60**	**191.05**	**2.52**	**2.51**	**2.52**	**1.83**	**5.58**	**2.71**	
SD	**16.38**	**5.48**	**0.14**	**0.19**	**9.80**	**5.48**	**5.93**	**0.14**	**0.17**	**0.15**	**0.12**	**0.23**	**0.12**	
TOTAL MEAN	**100.12**	**185.34**	**1.22**	**1.43**	**189.25**	**189.70**	**189.48**	**2.45**	**2.44**	**2.44**	**1.77**	**5.42**	**2.64**	
TOTAL SD	**17.38**	**6.29**	**0.31**	**0.38**	**9.28**	**6.21**	**6.60**	**0.14**	**0.17**	**0.15**	**0.12**	**0.29**	**0.14**	