

CHAPTER 5

INTERPRETATION OF RESULTS AND DISCUSSION

5.1 INTRODUCTION

As has been statistically proven, the intervention interceded during the 2002 Bankfin U21 Season, played a major role in the increase in the number of linebreaks achieved.

The following recommendations and observations are applicable to the future successful implementation of these new areas of focus in the coaching of backline play.

After an in-depth evaluation of all the matches was made, the linebreaks of the Blue Bulls U21 team were evaluated in the light of the discussion in chapters 3.

There were two key aspects that were to be explored in more detail:

1. the types of running lines or strike moves that achieved a successful linebreak during the season?; and
2. how much influence did the level of imposed intervention play in the successful linebreaks that occurred during the season?

These will be discussed in greater detail in the following discussion.

Table 5: Total linebreaks as identified during the 2002 Bankfin U21 Currie Cup

	BB "A"	BOR	FAL	LIONS	Natal	WP	FS	BOL	WP	LIONS	TOTAL
"Overs"	7	17	12	6	13	3	5		14	11	88
"Unders"	5	3	6	5	5	5	7		16	15	67
"1,1"	4	9	5	1	1	3	1		3		27
"Happy"	1	3					4		4	2	14
"X"		1	1		2	1	3		3	1	12
"Shark"	1	1	1			1			1		5
"ACT"	1	2	2	1					1		7
"Slap chips"			1			1			1		3
"DSP"			1								1
"O,I" Strike			1								1
Total	19	36	30	13	21	14	20		43	29	225

The most noticeable aspect from these results is the fact that of the 225 linebreaks in the season, an overwhelming number were restricted to five types of running lines or strike moves, namely:

- “Overs” (88 linebreaks);
- “Unders” (67 linebreaks);
- “1,1” (27 linebreaks);
- “Happy” (14 linebreaks); and
- “X” (12 linebreaks).

These five types of running lines accounted for 92% of the successful linebreaks achieved during the season. The two most successful means of linebreaks were interestingly enough both running lines and were not specifically aimed as strike moves.

One of the key reasons for this was the way the Blue Bulls U21 team attempted to play pattern rugby in order to create “mismatches” when they attacked the opposition’s defensive line. A “mismatch” can be described as situations where the team in possessions attacking forwards were able to run at the opposition’s backs, or where the attacking backs were able to run at the opposition’s forwards. These “mismatches” resulted in the maximum effect of a speed or power advantage over the opposition as will be seen later.

There were two specific means of beating the opposition namely by speed, or alternatively by power. At this stage of the discussion the key focus will be on those running lines and strike moves that relied predominantly on speed as there major contribution to the successful linebreak.

5.2 LINEBREAKS ACHIEVED THROUGH THE USE OF RUNNING LINES AND SPEED

If one was to look at the following tables the following observations can be made:

Table 6: “Overs” running lines

Team played	Δ in initial starting position	Δ in speed of movement	Compressed attack	Expanded attack	Decoy inside	Decoy outside	Side on contact	Opposition beaten by speed	Opposition beaten by power	Total linebreaks
BB “A”	3	7	4	1	2	2	3	7		7
BOR	5	5	3	4	7	3	6	15	2	17
FAL	3	1	4	1	5	1	6	9	3	12
LIONS	3	1		1	3	3	3	3	3	6
NAT	4		4	2	6	2	5	11	2	13
WP	1		1		2		2	1	2	3
FS	1		2	1	2	1	3	4	1	5
BOL										
WP	1		5	5	6	4	3	12	2	14
LIONS	2	1			4		2	11		11
TOTAL	23	15	23	15	37	16	33	73	15	88

There were a total of 88 linebreaks achieved from the execution of an “Overs” running line. The factors that played the most influence on the successful execution were:

Speed	(73/88)	83%
Decoy inside	(37/88)	42%

The most obvious observation is that speed played the largest part in its successful execution. There are two possible reasons for this:

1. due to the “mismatched” situations, the attacking backs were too quick for the defenders and thus were able to beat them with speed on the outside; and

2. if there was a situation where the attacking backs attacked their backs, a further two assumptions can be made, namely that the attacking backs were quicker than the opposition's backs, or the second factor namely the use of a decoy ploy on the inside created enough attention for the defenders thereby delaying their shift outwards, thus the attacking backs had more time and space on the outside in order to beat the defence with speed.

The second running line to have speed as its major part of its successful execution is that of an "X" or follow scissors running line.

Table 7: "X" running lines

Team played	Δ in initial starting position	Compressed attack	Expanded attack	Decoy inside	Decoy outside	Side on contact	Momentum advantage	Opposition beaten by speed	Opposition beaten by power	Total linebreaks
BB "A"										
BOR			1		1			1		1
FAL			1	1				1		1
LIONS										
NAT	1	1	1		1	1	1	1	1	2
WP	1		1	1	1			1		1
FS	1		2	1	1	1	1	2	1	3
BOL										
WP	1		2		3			3		3
LIONS					1			1		1
TOTAL	4	1	8	3	8	2	2	10	2	12

During the execution of an “X” running line, of the 12 successful linebreaks that occurred, the following three factors played the most predominant role in the running lines success:

Speed	(10/12)	84%
Expanded attack	(8/12)	67%
Decoy outside	(8/12)	67%

As can be seen speed accounted for 84% of its successful execution. It is important to note that speed in this instance does not apply to how attacking backs move towards each other, but instead refers to the speed with which the “one-out” striker comes into the strike.

What was clearly evident was the way the next two factors played a part in the success of the move. By combining an expanded backline attack with the bringing in of a decoy on the outside, the defenders were wrong footed and tended to move outwards on the shift too quickly. This together with the speed of the “one-out” striker coming in meant that the defenders were in no position to make the tackle thus resulting in the linebreak.

The third strike move or running line to have speed as its major contributing factor in terms of success is the “happy” running line.

Table 8: “Happy” running lines

Team played	Δ in initial starting position	Δ in speed of movement	Expanded attack	Decoy inside	Decoy outside	Side on contact	Momentum advantage	Opposition beaten by speed	Opposition beaten by power	Total linebreaks
BB “A”			1		1	1	1		1	1
BOR	1	3	1	1	2			3		3
FAL										
LIONS										
NAT										
WP										
FS	2	2	3	1	1	2	2	2	2	4
BOL										
WP	1	3	1		2	1	1	4		4
LIONS		2			2	2	2	2		2
TOTAL	4	10	6	2	8	6	6	11	3	14

During the execution of a “Happy” running line, of the 14 successful linebreaks that occurred, the following four factors played the most predominant role in the running lines success:

Speed	(11/14)	79%
Δ in speed of movement	(10/14)	71%
Decoy outside	(8/14)	57%
Expanded attack	(6/14)	43%

Again the definition of speed in this context is the speed with which the striker came through the space that was opened up by the decoy outside. The key to the successful execution was clearly evident due to a combination of factors.

The speed of movement refers to the player passing the ball stopping, before passing the ball to the striker coming through rapidly in order to create a situation where the defenders are forced to stop. This results in the striker having the advantage of running at a space while the defenders are shifting sideways and then are forced to stop immediately.

The decoy on the outside also played an important part in drawing the inside defenders across too early and thus advantage could be taken of the space created on the inside.

The expanded attack created a situation where the spacing between the defenders was slightly wider thus they “felt” that they needed to move across earlier onto the decoy on the outside thus making the strike more effective.

The fourth running line to rely on speed is the “shark” running line.

Table 9: “Shark” running lines

Team played	Δ in initial starting position	Δ in speed of movement	Expanded attack	Decoy inside	Decoy outside	Side on contact	Momentum advantage	Opposition beaten by speed	Opposition beaten by power	Total linebreaks
BB “A”	1		1	1	1			1		1
BOR			1	1	1			1		1
FAL	1	1	1	1	1			1		1
LIONS										
NAT										
WP			1	1	1	1	1		1	1
FS										
BOL										
WP	1		1	1	1			1		1
LIONS										
TOTAL	3	1	5	5	5	1	1	4	1	5

During the execution of a “Shark” running line, of the 5 successful linebreaks that occurred, the following two factors played the most predominant role in the running lines success:

Expanded attack	(5/5)	100%
Decoy outside	(5/5)	100%
Decoy inside	(5/5)	100%
Speed	(4/5)	80%

The “shark” running line had to be executed in the specific way as set out in figure 48. The two most significant factors to its successful execution were the expanded attacking formation and the speed with which the striker moved from the inside of the ball carrier to the outside in order to receive the pass. The concept of the decoy on the outside was also integral in the success of the strike as it opened up the space just outside the ball carrier. The decoy on the inside created a type of “legal” block on the inside so to slow down the shift of the defence across, this also contributed to the success of the striker. The expanded attack created the situation where there was wider spacing of the defence, this allowed the striker even a greater chance of being able to move through the defences line.

As discussed earlier, there are two means of braking the opposition, firstly by speed, and alternatively by power. This second aspect of power linebreaks will now be discussed fully.

5.3 LINEBREAKS ACHIEVED THROUGH THE USE OF RUNNING LINES AND POWER

If one was to look at the following tables the following observations can be made.

The first running line relying on power for its successful execution is an “unders” running line.

Table 10: “Unders” running lines

Team played	Δ in initial starting position	Compressed attack	Expanded attack	Decoy inside	Decoy outside	Side on contact	Front on contact	Momentum advantage	Opposition beaten by speed	Opposition beaten by power	Total linebreaks
BB “A”	1			1	2	3	2	5		5	5
BOR	2	1	2	3	1	1	1	2	1	2	3
FAL	1	1	2	3	2	2	2	4	2	4	6
LIONS	1		5	1		3		3	2	3	5
NAT	1		2	1	2	4	1	5		5	5
WP	2	2	1	1	2	4		4	1	4	5
FS	2	2	2	1	2		4	4	3	4	7
BOL											
WP	3	1	7	1	1	8	2	10	6	8	16
LIONS	6		4	1	3	7	1	8	10	5	15
TOTAL	19	7	28	13	15	32	13	45	25	40	67

During the execution of an “unders” running line, of the 67 successful linebreaks that occurred, the following three factors played the most predominant role in the running lines success:

Momentum advantage	(45/67)	67%
Power	(40/67)	60%
Expanded attack	(28/67)	42%

The execution of an “unders” running line resulted in 30% (see table 3) of the total linebreaks achieved during the season. This running line was especially successful after quick recycled possession where advantage could be taken of the “mismatches” that were created, mainly through forwards running at backs.

The “unders” line made predominant use of power for its successful execution. It was also positively influenced by an expanded attacking formation as this created greater spaces on the outside for the striker to move through.

It was also evident that a momentum advantage (67%) into the contact area was necessary for the successful execution, as can be seen from table 4.

The second running line relying on power for its successful execution is the “1,1” running line.

Table 11: “1,1” running lines

Team played	Δ in initial starting position	Compressed attack	Expanded attack	Decoy inside	Decoy outside	Side on contact	Front on contact	Momentum advantage	Opposition beaten by speed	Opposition beaten by power	Total linebreaks
BB “A”	1		1		1	1	3	4		4	4
BOR	2		3		1	2	4	6	3	6	9
FAL	2	1	2	1			3	3	2	3	5
LIONS		1			1				1		1
NAT							1	1		1	1
WP	1		2	2	2		1	1	2	1	3
FS	1	1							1		1
BOL											
WP	2	1				1	1	2	1	2	3
LIONS											
TOTAL	9	4	8	3	5	4	13	17	10	17	27

During the execution of a “1,1” running line, of the 27 successful linebreaks that occurred, the following four factors played the most predominant role in the running lines success:

Power	(17/27)	63%
Momentum advantage	(17/27)	63%
Δ in initial starting position	(9/27)	33%
Expanded attack	(8/27)	30%

As with the “unders” running line, the 1,1 running line was primarily reliant on the speed of the presentation of the ball after phase play for its success. The reason for this was that if a 1,1 was run off slow recycled possession where the defenders organisation was in place, the striker would be “double hit” by the opposition defenders and didn’t manage to get over the contact line which was behind the advantage line.

Power and a momentum advantage into the contact were vital for this running line to be successful. This “brute” force was however aided by the following two factors namely a change in the initial starting position as well as an expanded attacking formation. The reason for this became apparent after observation of the successful strikes and can be explained as follows. By shifting the backline as a unit outwards, the opposition’s defensive line became slightly too “tight” in terms of their alignment on each of their specific defenders. This aided by the slightly more expanded attacking unit, tended to create a situation where the opposition’s field coverage was not quite sufficient in order to stop the attacking backline in terms of covering all the defenders.

This resulted in the defenders not being able to get into a position to stop the player coming in on the “1,1” strike. If the defender was able to get into this defensive position, he was however unable to make a dominating tackle thus the striker was able to break through the defensive line. This occurred most often, thus being seen by the high values of the contact involved in the running line.

After the evaluation of all the striking situations during the Blue Bulls Bankfin U21 season of 2002, the following scientific principles were identified as the reasons why the intervention according to the laid down principles during the coaching of the team resulted in a marked increase in the number of linebreaks.

When the Blue Bulls team endeavoured to break the defensive line of the opposition, there were certain scientific principles that played a role in whether the attempted linebreak was successful or not. It became evident through the course of the study that it was the application of these scientific laws of movement that was in the most cases the reason for a successful linebreak.

In order to attempt to explain the results a discussion concerning force, Newton's laws of movement as well as other pertinent concepts will be explored.

As has already been stated, the object of an attacking strike is to drive forward with the intention of beating the defender while attempting to cross the centre line of the contact area by applying maximum contact forces on the opposition defender (McClymont & Cron, 2002).

According to Newton's principles, objects move when acted upon by a force greater than the resistance to movement provided by the object. This force involves the interaction of two objects and produces a change in the state of motion of an object by pushing or pulling it (Beer & Johnston, 1990; Young, 1992; van Staden et al., 1992; Hamill & Knutzen, 1995).

This statement can be applied directly to contact situations arising from attempted linebreaks. As a result of this collision and in this context, a force can be defined as any interaction, a push or a pull, between two objects that can cause an object to accelerate either positively, i.e., break through the tackle, or negatively, i.e., be tackled backwards (Hamill & Knutzen, 1995).

5.4 CHARACTERISTICS OF A FORCE

Forces are vectors and as such have the characteristics of a vector – magnitude and direction. Magnitude represents the amount of force being applied. It is also necessary to state the direction of a force because the force could have a different effect, depending, for example, if the force is pushing in one direction instead of pulling in the other (Beer & Johnston, 1990; Young, 1992; van Staden et al., 1992; Hamill & Knutzen; 1995).

This would imply that the running lines that gave the striker a momentum advantage over the defender with sufficient space to play through while coming in on an advantageous angle were the most successful strikes that resulted in the linebreaks.

Vectors are usually represented by arrows, with the length of the arrow indicating the magnitude of the force and the arrowhead pointing in the direction in which the force is being applied (Beer & Johnston, 1990; Young, 1992), e.g.,

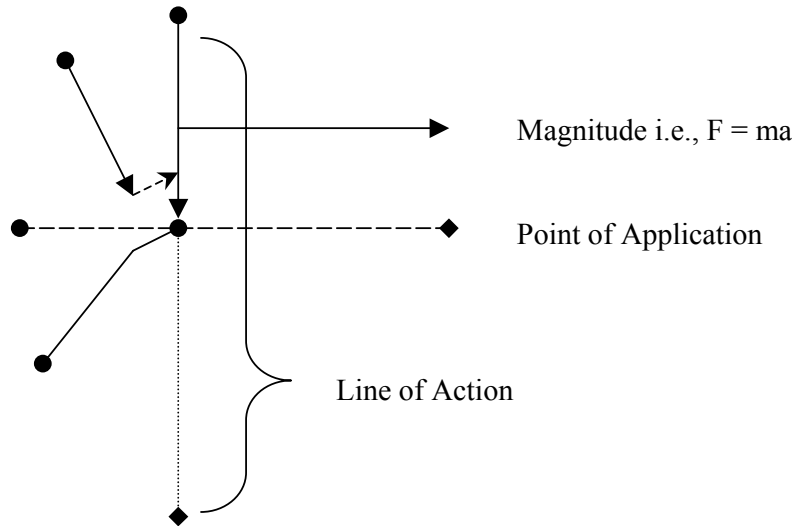


Figure 56: Vectors involved in a linebreak

Forces have two other equally important characteristics: the point of application and the line of action. The most important of these two characteristics is the point of application of a force which can be described as that specific point at which the force is applied to an object or in this case a person (Hamill & Knutzen, 1995).

This point of application in a rugby context takes place where the striker and defender meet at impact. This is probably the most important aspect of the attempted linebreak as the team that dominated this area was the team that had the greatest likelihood of either achieving or stopping the linebreak.

5.5 SPEED / FORCE APPLICATION

The magnitude of force that is applied by one player upon the other is proportional to the mass of the player, and the rate of change of velocity (acceleration) at impact.

When evaluating the strike moves it will be assumed that both the attacker and defender were of similar mass. The principle of conservation of momentum ensures

that the player that is moving faster at impact will apply a greater force and that he will tend to maintain his forward momentum rather than be tackled backwards (McClymont & Cron, 2002).

An aspect of speed / force application that is more appropriate to the rugby situation involves how the striker and defender meet at impact / contact. As mentioned earlier, the speed into the strike zone plays an important role in the conservation of momentum thus resulting in a greater force being applied onto the defender.

There were four possible contact angles that resulted in different outcomes. Although the amount of force and momentum taken into the contact had to be sufficient so to take the striker over the point of application, i.e., he had a momentum advantage, the end finishing result was dependant on the angle with which the striker made contact with the defender.

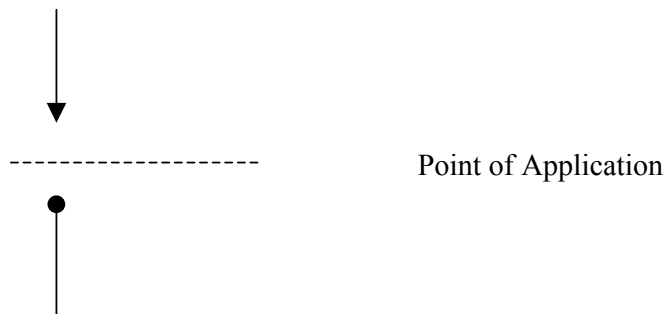


Figure 57: Head on head contact (Domination of the tackle with greater momentum)

In this situation the player with the greater momentum or force into the contact area will get over the point of application. There were practical problems for the striker that developed, namely that if the striker did dominate the tackle and continue moving forward, it was a difficult contact area to manage for his support players as the striker tended to fall over the defender thus excess bodies were bundled in a small area thus the ability of the supporting players to recycle the possession in that area was made difficult.

Another problem that was identified in this situation was that it more often than not occurred that there were two tacklers in this situation who were able to execute a “double hit” or “gang tackle” involving more than one tackler hitting the striker thus the striker did not get over the contact line or line of application. It also became evident that this type of strike occurred in the absence of decoy runners working with the striker.

The reason for this was that it tended to take place from quick, recycled possession with the ball carrier running onto the defenders who were too slow in being able to realign in their defensive positions quickly enough. It was unsuccessful from slow ball and if the ball wasn't turned over in contact the players were tackled backwards putting the attacking team under pressure.

After continued evaluation of matches it was determined that this type of strike was effective, however, it could only be successful from quick recycled ball with players coming out of a stream running at ill prepared defenders. In this situation the defenders were not mechanically strong due to lack of time in preparation for the tackle and not through manipulation from the attacking teams decoy runners and running lines.

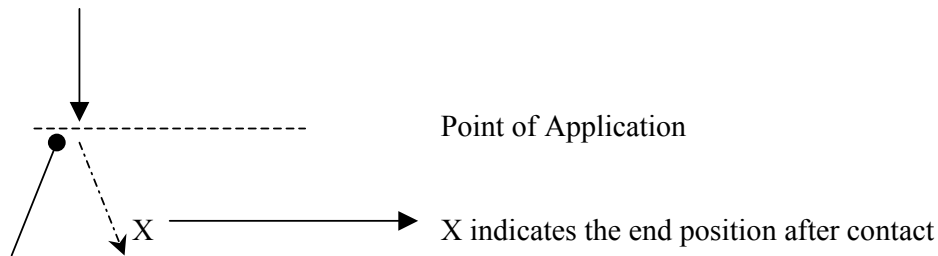


Figure 58: Head on contact (domination of the tackle)

The tackled player was able to dominate the tackle and there were two results that occurred during the matches played. On occasion players broke through the tackle resulting in a clean break. It also occurred that the striker was able to position himself in a way to be able to get an off-load away in the tackle. The reason that this type of contact was the most successful was that the striker was able to take maximum

momentum into the tackle. He also had the advantage that when he made contact with the defender it was made with his “hard” body parts that the defender had to contend with as he was running at the defender and not away from the defender. This meant that the striker was better equipped to “bump” off the tackle. As can be seen from the probable end position after the tackle, the line of action is still in favour of the striker thus the advantage would lie in the hands of the attacking team.

This form of strike tended to take place off organised play where the attacking team endeavoured to break through the defence with force. This form of strike normally took place with the use of decoy plays however they tended not to be as successful in manipulating the defenders as would have been liked.

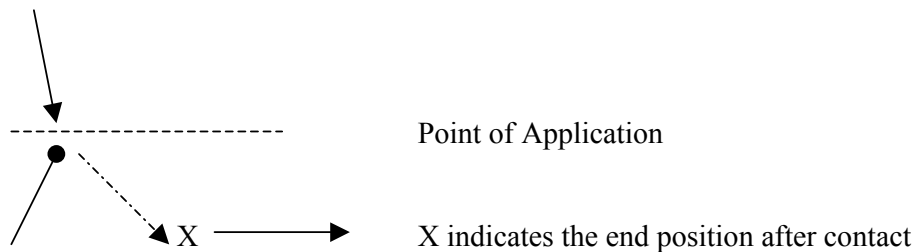


Figure 59: Side / Head on contact (domination of the tackle)

The tackled player was able to dominate the tackle however was not as effective as in the previous examples. In this situation, the striker was still able to dominate the contact and be able to impose his “hard” body parts onto the defender however their was more “soft” tackling area exposed and if the defender was able to track the striker well it could make the contact situation less pleasurable for the striker. In terms of the probable end position of the striker after the contact, it still held a favourable result with the attacking team maintaining their forward momentum.

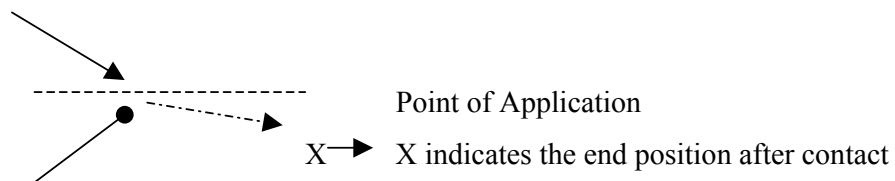


Figure 60: Side on contact (non - dominance of the tackle)

In this situation the tackler dominated the contact area. When this happened, the attacking supporters found it difficult to support the striker as the momentum was with the defender who was able to tackle the striker backwards. The striker was still to a degree able to maintain his go-forward momentum, however it was not enough to continue the go-forward dominance which is required to give the attacking team the necessary momentum so to be able to dominate the defence.

The whole situation resulted in poor outcomes for the attacking team, namely,

- The tackler was able to execute a dominating hit on the striker resulting in a positive psychological advantage for the defenders.
- The angle of how the striker and tackler met lead to the tackler's "softer" body parts being exposed thus resulting in a more debilitating tackle being executed.
- The tackle direction took the striker towards the next defender out which resulted in that defender being able to get to the breakdown point first thus the possibility of a turnover.
- The angle the cleaners come from makes it difficult for them to come in from an on-side position, as they have to approach the tackle area from the hind most feet.

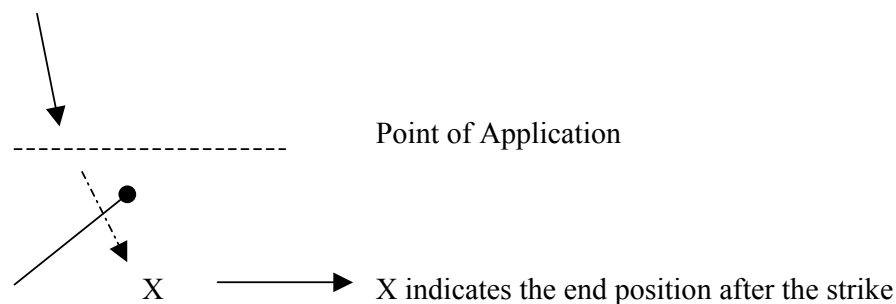


Figure 61: Clean break

A clean break was the result of three situations that took place, it either occurred due to the decoy ploys together with the attacking running lines manipulating the defenders to such an extent that they could no longer handle the defensive situation, or there was a wide strike with too many extra players on the outside and the ball was successfully shifted outwards and the clean break occurred on the outside.

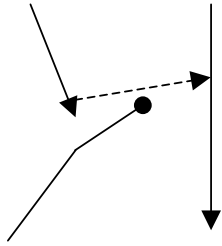


Figure 62: The use of an extra player on the outside

The third situation resulted from an outside gap being taken using an “overs” running line and the striker having a running speed advantage over the defender.

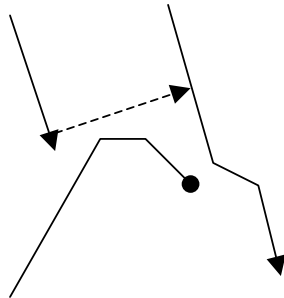


Figure 63: An outside gap taken with a line being broken by speed

As can be seen the mass and velocity with which the striker enters the impact / contact area is important, however, the angle with which the striker comes in on also influences the striker's ability to “use” his momentum and force. The running lines that the team executed that had an advantageous attacking running line tended to result in more positive outcomes when executed optimally incorporating all the aspects mentioned in the section regarding the experimental intervention.

5.6 THE DIRECTION OF THE FORCE

The direction in which each player applies forces is determined by the body posture of the player in relation to the point of application (Bartlett, 1999), and in relation to others (Quarrie & Wilson, 2000).

In a contact situation where the attacking ball carrier impacts on the defender the most important emphasis on body posture is applicable more so on the defending tackler than as is appropriate to the striker. The striker is focussed on hitting through a space near to the tackler with as much momentum as possible with the ultimate goal of breaking through his grasp.

For the tackler however, the importance of vertebral column alignment in the transfer of his tackling force is of importance. The phrase “spine in line” is commonly used to describe the optimum body position of a player approaching a tackle: the tackler’s shoulders and hips should be at the same height, and his head up to transmit forces through the shoulders at an angle as near to horizontal as possible. An essential component of body posture in the tackle must be the angles at the hip, knee and ankle joints, both prior to and during force application (ACC Rugby Smart, 2001).

This is a significant factor in force application technique (McClymont & Cron, 2002). The importance of these postural concepts is as applicable to the striker’s level of success as what his momentum is when impact is made. The reason for this is that as an attack needs to be organised according to the principles as laid out in the section regarding the intervention to be applied to the team, if the tackler is not able to position himself according to the above mentioned optimal defending body positioning, even a lack in striking momentum from the striker would be sufficient to break through the tackler’s arms and achieve the linebreak.

5.7 ENERGY

Energy is the capacity to do work. In biomechanics the main concern is with mechanical energy. Mechanical energy has two forms – kinetic energy and potential energy. Kinetic energy (KE) refers to the energy resulting from motion. An object or person possesses kinetic energy when it is in motion, which is when it has velocity. Linear kinetic energy is expressed algebraically as:

$$KE = \frac{1}{2} mv^2$$

where m is the mass of the player and v is the velocity with which he moves. What is important to notice from the equation is that the velocity is squared. What this implies is that any change in velocity will greatly increase the amount of energy the player has when approaching the impact area (Hamill & Knutzen, 1995).

The way in which this aspect of science influenced our attacking strikes can be seen in the way the striker was able to accelerate rapidly as he went for the gap. It was noticeable that if the striker approached the strike zone with a uniform velocity, the defenders were able to get into place and were better able to stop the strike. However, when the striker was able to accelerate into the strike it seemed as though the defender was lured into a feeling of being in control of the situation. With the sudden acceleration the striker caught the defender off guard and secondly the increased speed allowed the striker to enter the impact area with greater energy.

5.8 NEWTON'S FIRST LAW – THE LAW OF INERTIA

The fundamental role of force is to change the state of motion of a body on which the force acts (Beer & Johnston, 1990; Young, 1992; van Staden et al., 1992; Hamill & Knutzen, 1995).

Newton's first law of motion states:

“Every body continues in its own state of rest, or of uniform motion in a straight line, unless it is compelled to change that state by forces impressed on it” (Beer & Johnston, 1990; Young, 1992; van Staden et al., 1992; Hamill & Knutzen, 1995).

This implies that if no net force acts on a body, the body either remains at rest or moves with a constant velocity in a straight line. After observation of the games played during the season, it became evident that Newton's first law was applicable to how the opposition defenders were manipulated into weak defensive positions by “imaginary” forces created by the decoy runners on either side of the strike zone.

During the execution of the strike, the striker and defender met at the contact area. However before this contact area develops, the players move towards each other with different velocities and with different lines of approach.

This approach by both the attacker and defender results in the concept of inertia becoming evident that can be defined as the tendency of a body to remain at rest, or to keep moving once it has been set in motion. The situation preceding contact involves many forces acting on the players before, during and after contact. The use of running lines creates “imaginary” forces that are exerted on the defenders in order to manipulate them.

When these forces act on the defenders, it changes the state of motion of the defenders. A player who is initially at rest will start to move. If the player is moving, a force in the opposite direction to the motion will cause the player to slow down or stop. The result is that if a defender has line of defence, and a decoy runner together with the ball carrier’s running line does not manipulate the defender, the defender will not have to change his path of run and will be able to maintain his defensive line and thus be able to stop the attack.

If however the decoy runner and ball carrier are able to exert a force on the defenders and manipulate them accordingly, their defensive line can be changed, thus creating conditions that could be conducive to a line break. What became evident was that the importance of the decoy ploys to take the defenders out of their defensive shape was instrumental to the success of the strikes and without them our level of linebreaks would not have been as high as it was.

5.9 NEWTON’S SECOND LAW – THE LAW OF ACCELERATION

“The change of motion is proportional to the force impressed and is made in the direction of the straight line in which the force is impressed” (Beer & Johnston, 1990; Young, 1992; van Staden et al., 1992; Hamill & Knutzen, 1995).

Newton's second law generates an equation that relates to force, mass, and acceleration. This relationship is:

$$\text{Force} = \text{mass} \times \text{acceleration}$$

or

$$F = ma$$

In this equation, the force is the net force acting on the object in question, that is, the sum of all the forces involved when the defender attempts to halt the striker who is attempting the linebreak. In adding up the all the forces acting on the defender it is important to take the direction of the forces into account. If the net force produces acceleration, the accelerated object, i.e., the striker, will travel in a straight line comparable to the line of action of the net force (Hamill & Knutzen, 1995).

5.10 MOMENTUM

The factor that probably had the biggest influence on the success of strikes was the aspect of momentum of the strike on impact. What became evident during the season was the fact that when the striker and defender met, if the striker had sufficient momentum, if he wasn't able to break through the tackle, he was able to get over the contact line resulting in good go-forward possession from which attacking play could continue (Evert, 2001a).

Momentum is closely related to the force the striker takes into an impact situation between the striker and the defender. By re-arranging the equation described by Newton's second law, it becomes possible to determine what the momentum is of the striker when he enters the impact area.

Acceleration is described as $\frac{dv}{dt}$

By substituting this expression into the equation of the second law:

$$F = \frac{mdv}{dt}$$

The product of mass and velocity in the numerator of the right hand side of the above equation is known as the momentum of the striker. Momentum can thus be described as the quantity of motion that the striker takes into contact. Finally it should be noted that the force is equal to the time rate change of momentum. To change the momentum of the striker, an external force must influence the striker that he has to change. The momentum may increase or decrease, but in either case, an external force is required (Hamill & Knutzen, 1995).

The reason that momentum is vital to the success of a strike is that even if all the other aspects of the attacking play that is applied to the coaching of the team is correctly executed, if the striker doesn't have a superior force and momentum on impact the strike will not be successful. The defender will have sufficient force to be able to cancel out the strikers momentum, thus the strike will be ineffective.

This law affects the outcome of contact situations when the striker and defender meet. A further application of it can be seen in the following discussion: A key fault many inexperienced players made was to slow down once they received the ball as they were to make contact with the opposition defender. This had a marked influence on the player's momentum into the strike. If one was to give a hypothetical example of the force a striking player would exert in terms of his momentum, it could look as follows:

If a striker has a mass of 85 kg and is running at a speed of 4.5 m/s, his momentum would be:

$$\begin{aligned} p &= \text{mass} \times \text{velocity} \\ &= 85 \text{ kg} \times 4.5 \text{ m/s} \\ &= 382.5 \text{ kg-m/s} \end{aligned}$$

This value indicates the momentum the striker would have if he made impact with the defender without slacking off during the execution of the strike. As previously mentioned, one of the faults made by the players was that they tended to slow down as they were about to make contact with the opposition. If one was to adjust the equation appropriately, it becomes noticeable that the amount of momentum the player takes into contact becomes drastically reduced.

$$\begin{aligned} p &= \text{mass} \times \text{velocity} \\ &= 85 \text{ kg} \times 2.5 \text{ m/s} \\ &= 212.5 \text{ kg}\cdot\text{m/s} \end{aligned}$$

It becomes evident that the striker's momentum decreases from 382.5 kg·m/s to 212.5 kg·m/s a decrease of 170 kg·m/s. This shows a decrease of 170 kg·m/s in momentum into the strike.

It was obvious that the players who were more accustomed to striking were better able to impose the maximum amount of force and momentum into each strike. The following was identified as possible reasons why the more experienced players were able to maintain their momentum into a striking situation.

1. The more experienced players had been exposed to the scientifically based strength programs for a longer period of time and thus were both physically and mentally better equipped to apply maximum force and momentum into the strike. They tended to have more confidence in the physical ability of their bodies and tended to not hold back when going into contact.
2. Another of the reasons why players tended to slacken off in velocity before contact was their inability to identify where the attacking space was and thus be able to pick the area of impact and apply full attack there. They didn't possess the "feel" necessary for identifying where the space was to open up and thus had to adjust their line of strike by slowing down and then moving to where the space was. The key coaching point of the execution of the strike was to create the situation where the striker made contact with the defender's arms and not his shoulder, this made the possibility of a linebreak higher as

the defender was forced into a situation where he had to grasp and was not able to dominate the tackle situation.

Wakeman (2002) makes an interesting observation regarding attentional focus and reaction time. He feels that the ability to focus one's attention (i.e., to read) and react in explosive sports often appears to be at least as important as movement time for successful power performances.

Watching a striker get flattened by a defender on a misdirected strike illustrates this point. In many cases the striker gets crushed not because he was not explosive, but because he did not have a correct read (focus) and / or did not demonstrate good reaction time.

Athletes can have awesome explosive capabilities from the neck down but never get to use them effectively because of limiting factors (mental focus problems and reaction time deficiencies) from the neck up. Athletes may have a big, powerful gun (body) but if they cannot pull the trigger (read and react appropriately) under competitive conditions, the size of the gun and speed of the bullet (explosive movement speed) become irrelevant.

Few, if any, other factors influence the expression of sport explosiveness more than attentional focus and reaction time.

This aspect of attentional focus and reaction time was influential in every striking situation by the teams attacking units. Due to the dynamic nature of the game it never occurred that the defenders and strikers met at the same situation, at the same time or in the same place. This meant that the space through which the striker was to move varied as well as the distance between the spaces through which the striker was to move varied. This in a rugby context was the area where the players needed to apply their attentional focus and reaction time.

In order to discuss this application of attentional focus and reaction time it is necessary to recap on the concept of taking momentum into the strike. As was indicated earlier, if a striker decreases his velocity into contact, he dramatically decreases his amount of momentum he can take into the contact area.

The difficult aspect the players have in this regard is that they tended to battle with the way their ability to identify the space and then to go for the strike. At times it occurred that they did not get their striking angle correct and then had to adjust in order to “hit” the space. This is not something that can be coached however the player’s ability to adjust can be improved thus the amount of momentum taken into contact is not affected too dramatically.

When this problem was identified, the key factor that played a role in keeping the momentum was the type of movement style used when changing direction. Through evaluation it became evident that if the player changed direction in a way that maintained normal running technique then the change of direction did not affect the momentum of the player into contact.

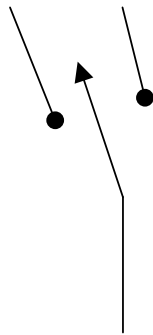


Figure 64: A change in running technique that does not dramatically reduce the amount of momentum into contact

The mistake the players tended to make which had a direct result on the amount of momentum taken into contact was that they tended to “shuffle” side ways and then tried to accelerate forward. This created the situation that where the player who just adjusted his line of strike to subtle sideways shoulder adjustment to change the line of movement managed to keep his momentum, the players who “shuffled” tended to “lose” a significant amount of momentum and then still had to accelerate from a “standing” start.

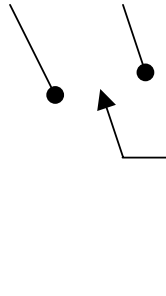


Figure 65: A change in running technique that does dramatically affect the amount of momentum into contact

Once this aspect was adjusted the player's momentum in contact was maintained at a reasonably high level for most of the situations evaluated.

5.11 NEWTON'S THIRD LAW – THE LAW OF ACTION–REACTION

“ To every action there is always opposed an equal reaction; or, the mutual action of two bodies upon each other are always equal and directed to contrary points ” (Beer & Johnston, 1990; Young, 1992; van Staden et al., 1992; Hamill & Knutzen, 1995).

Newton's third law illustrates that forces never act in isolation but always act in pairs. This implies that when two objects interact, i.e., when the force executed by a striker is counteracted by a force equal and opposite exerted by a defender, these forces are equal in magnitude but opposite in direction. The result is that these two forces cannot cancel each other out since they act on and may have a different effect on the objects, i.e., the player applying the greater force is not moved backwards. To explain how this affects two objects coming into contact with each other, an example involving a person landing from a jump will be used. A person landing from a jump exerts a force on the earth, and the earth exerts an equal and opposite force on the person. But because the earth is more massive than the individual, the effect on the individual is greater than the effect on the earth. This type of situation can be applied to one where the striker and defender meet at impact. The forces don't cancel each other out, however they do have a different effect on either the striker or defender depending on the result in contact (Evert, 2001a).

5.12 CONCLUSION

Many sports require the expression of great speed and power for success. There are many areas and strategies currently available to improve sport explosiveness. At the present time, there does not appear to be one best method or recipe to improve speed and power for all athletes in all sport situations. Each sport, position, and circumstance should be analysed to decide how speed and power could be modified to maximize performance.

Realistic training and performance goals should then be set based on the speed and power improvement possible. Coaches and athletes need to understand that motor abilities like speed of limb movement, explosiveness and flexibility, to a large degree, are genetically predetermined.

For example, Wilmore (1982) suggests that sprint speed may only be enhanced about 10% through training. Olympic history supports this hypothesis. In 1900 Jarvis, from the USA, set the Olympic 100-meter dash at 11 seconds. In 1980, Wells from Germany, set a new 100-meter dash mark of 10.25 seconds, an improvement of only 0.75 seconds over an eighty-year period (Komarek, 1998).

This actuality tells all that speed and explosiveness can be improved, but not to a large degree. It suggests to coaches that recruitment of gifted (explosive) athletes should be the first priority (if speed and explosiveness are an important part of the game). More importantly, it tells competitors that the purchase of magical training recipes and equipment are ill advised at best. The demonstration of sport specific explosiveness comes from a combination of genetics; intelligent coaches who know how to communicate their training knowledge and athletes who are motivated to use that knowledge (Wakeman, 2002).

For this reason a coach can influence the performance of his team, however, there will always be limitations and problems involved in the striving towards this higher level of performance. Coaches shouldn't put boundaries onto their creativity in coaching, it is these ideas that together with the coaches ability to mix the science and art of coaching on the rugby field that will result in the team coming close to achieving all that they can in planned attacking backplay.

5.13 RECOMENDATIONS

After all striking situations were evaluated during the season, the following key aspects were identified as cardinal to successful linebreaks

The following forces were involved and played an integral part in the success of linebreaks:

- speed of movement (velocity) of both the striker and defender.
The velocity of the striker at the impact is the most important factor affecting the force and momentum, if the striker has a momentum advantage it will ensure a more effective strike;
- the mass of each player.
As has been discussed, momentum and force are both influenced by the mass of the striker. This factor has less influence on the striker's momentum and it is also not possible to influence this variable, it does play a role in the success of a strike;
- the centre of mass of the defender.
This involves the manipulation of the defender's shoulders so that their centre of mass is such that they are not able to adjust their body positioning so that they are optimally able to ward off the attack;
- the striker should have a momentum advantage.
This will create the situation where the striker is able to break through the tackle or otherwise be in a position to get over the contact line and thus ensure good go-forward momentum for the team; and
- the striker should have a kinetic energy advantage.
This together with the momentum will give the striker an advantage when entering the contact area.

The following situations existed and influenced whether a strike was successful or not.

- The striker had sufficient momentum to break through the tackle, i.e., the defender was momentarily forced to stand still when the tackle was to be executed.
- The defenders were mechanically weak and could not re-align to be able to be in a position to make the tackle, i.e., the defender was manipulated into moving in the wrong direction and couldn't reverse their momentum.
- The defenders were drawn away from the strike zone so that there was a hole through which the striker could move, i.e., the defenders were overloaded with defensive options.
- The striker is momentarily stopped in contact however is able to offload to a trailer coming through in support.
- The defenders were kept in their defensive channels as long as possible before being "allowed" to shift outwards, i.e., there was a preservation of space on the outside and the covering defence were committed on the inside.
- 15 vs 7 attack, i.e., by running at the defender you force him to wait for the attack as a defensive decision has to be made. This allows the attackers to get in ahead of their own forwards allowing the supporters coming through to be able to run onto the situation and not backwards before being able to the approach the facet.