

Level III
Coaching Course
'Maximizing the Effectiveness
& Transfer of Training to
Performance in Rugby'

INTRODUCTION

An extremely important aspect of effective coaching, is an increased need for training methods to enhance functional decision-making. In order to achieve this, training drills need to be 100% specific to performance (Magill, 1993) and the format of training sessions need to be structured so that they transfer directly and positively to performance.

The aim of this paper is to address a practice scheduling technique, well documented in motor programming literature that enhances positive transfer from training to competition. The technique examined is 'contextual interference'.

The paper will initially examine the main limiting factor in relation to coaching effectiveness, how this is addressed at elite and sub-elite level, (with particular emphasis on training structure), based on current motor programming, and skill acquisition knowledge. Recommendations based on applied contextual interference literature will then be proposed as to how training to performance transfer can be enhanced, at both club and elite level.

The inferences made in relation to current training techniques are derived from a theoretical and applied reference base. The former will examine relevant studies on various sports, which seek to define the boundaries and limitations of contextual interference in relation to enhancing skill acquisition, and in particular, maximizing the transfer from training to performance. The latter is based on observations of elite (Super 12 and ACT Rugby Academy), and sub-elite (Sydney, Brisbane and ACT first grade) training sessions over the past three years.

THEORETICAL BACKGROUND

The main constraint to successful rugby coaching at any level is - TIME! At international level the challenge for Australian coaching staff is to take a group of players from three Provinces, who have been training and playing under three different structures and styles, and further adapt them to the different Wallaby style. In order to compete at or near 100% against New Zealand Maori in 2002, this had to occur in three short weeks. Similarly, a club coach whose contact with players is between 3 1/2 & 5 hours per week, the greatest limiting factor to their coaching effectiveness (assuming they are a reasonable coach) again is - Time!

How then does a Rugby Union coach maximize the amount of training time he has with the players in order to enhance transfer to performance?

In order to answer this question, a summary of basic motor programming theory is required. An applied model of skill acquisition as proposed by Fitts (1964), details three stages of skill acquisition:

1. The Cognitive Stage
2. The Associative Stage
3. The Autonomous Stage

The Cognitive Stage:

Defines the first stage of skill acquisition. This stage is characterized by the subject's attempt to understand the nature of a particular skill. This engages a large amount of mental effort and is subject to a variety of feedback, received from both internal and external sources.

The Associative Stage:

Often referred to as the 'Practice Stage', this is where the subject gains a better understanding of the movement pattern required to execute a particular skill. The subject is also able to adapt the movement pattern to differing stimuli or external circumstances. The subject slowly gains consistency in skill performance, having to engage less mental effort than the cognitive stage to execute a particular motor skill.

The Autonomous Stage:

The final evolutionary stage of skill acquisition, where the execution of a particular skill becomes automatic, and the skill can be performed with minimal mental effort by the subject.

In conjunction with the three stages, there are two types of environments where skills are executed and learned:

Open Environment - Conditions subject to rapid and continual change. Responses to these types of environments must also subsequently be rapid. Speed and accuracy of skill execution are dependent upon the subject's ability to process information from various changing stimuli, and choose the correct response quickly - functional decision-making. (Shea et al, 1993)

Closed Environment - Stable environment, where conditions generally remain constant. Responses can be planned in advance. (Shea et al, 1993)

Rugby, by its very nature, is an extremely open environment type game. Subsequently, training at the advanced level needs to be 100% game specific and must also occur in an open environment. This is where the use of Contextual Interference becomes a pertaining issue.

The Contextual Interference phenomenon, first proposed by W.F. Battig in 1966, was defined as the interference that occurs when tasks are practiced in a particular context. Low interference is observed when subjects practice a single task repetitively (Blocked Format), and high interference is observed when subjects practice a number of different tasks randomly in the same session (Random Format).

Its importance in relation to enhancing the effectiveness of training is well documented. Experiments were initially conducted in laboratory settings, however, more recently in more applied/field type settings. A large body of literature suggests that the random formatting of practice of various types of skills yield poorer training performance, but better retention and transfer into game performance. Conversely, Blocked type training yields better training performance, but poorer retention and transfer into game performance. (Shea & Morgan, 1979)

Applied literature that support the above notion are Goode & Magill (1986), in taking thirty female subjects and had them practice three different types of badminton serves in blocked, random & serial fashion for three days per week over a period of three weeks. Results in both retention and transfer significantly support the above hypothesis. Smith & Davies (1995) applied random practice Vs blocked practice in the practicing of the Pawlata roll for a group of inexperienced kayaker's. The first group practiced the roll in blocked fashion on one side before practicing in blocked fashion on the other side. The second group randomly practiced the roll on both sides. Results indicated that the random group took less time to acquire the skill and performed the skill (on both sides), better in

retention tests one week later. The increased acquisition time for the random group in this study in comparison to the blocked group has interesting implications, as the author's suggest that random practice should be introduced as early as possible for closed type skills, even with low skilled athletes. Recommendations for the introduction of random practice in relation to skill level are addressed in more detail, later in this article.

However, the most relevant and applicable study in relation to Rugby in terms of the Open nature of the skill being performed was Hall, Domingues & Cavazos (1994). Their study related to the batting performance of skilled collegiate baseball players in the United States. The study consisted of three groups: Control Group, which performed no extra practice. The Block Group which received 45 pitches - 15 fastballs, 15 curveballs & 15 Change-up pitches in blocks of fifteen, received via two extra sessions per week. Finally, the Random group, which received the same number of pitches, the same number of each types of pitch, however in random order, also in two extra sessions per week.

Pre-test analysis showed that there was no significant difference between groups, however after six weeks, transfer tests yielded the following significant results:

Random group: 56.7% improvement

Blocked group 24.8% improvement

Control group: 6.2% improvement

Whilst there is a large body of literature that supports the Contextual Interference effect in terms of practice scheduling, there is also a large body of literature which sets about defining the limits of it's effectiveness in relation to the skill level of the subject during practice. Bortoli, Robazza, Durigon &

Carra (1992) for example, concluded in favor of random practice as an effective means of enhancing transfer to performance. However, they also resolved that the effectiveness of random training is diminished as the skill level of the athlete decreases. Results of this study indicate those subjects with little or no experience with the assignments to be practiced would benefit greater from blocked type practice until skill level increased, before introducing random practice. French, Rink & Werner (1990) & Brady (1998) concur with this hypothesis.

The reasons for this can be related back to Fitts' (1964) 'Stages of Skill Acquisition', in association with the amount of mental effort required in the execution of motor skills at each level. During the cognitive stage, the mental effort to execute a motor skill is great, as the subject endeavors to understand and processes information from both internal & external stimuli. Subsequently, any further interference to the execution of the motor skill would only hinder the cognitive process. At this point Blocked type practice in a closed type environment is recommended. This is particularly true with open type skills. However, as the subject skill level begins to evolve between the associative and autonomous stages, the introduction of contextual interference should be used as a means to enhance retention and transfer. (Farrow 1996, Farrow 1998, Merrick et al 1999, Farrow 2000)

Table 1. Proposed by Farrow (1998) adequately summarizes literary recommendations for the introduction of Contextual Interference in relation to skill level and the nature of the skill being performed.

Table 1.

SKILL LEVEL	SKILL TYPE	PRACTICE	INTERFERENCE
BEGINNER	Open Closed	Blocked	Low
INTERMEDIATE	Open Closed	Block/Random Random	Medium High
ADVANCED	Open Closed	Random	High

Therefore, how is the above-mentioned motor-programming theory, with particular reference to Contextual Interference, being utilized to maximize transfer from practice to performance in Rugby Union?

APPLIED BACKGROUND

Observations of Elite (Super 12) training sessions over the past six months, has established that training is based on similar literature to that outlined above. Skills are broken up into the cognitive components, and practiced in a closed type environment in block fashion in order to address all the technical aspects that compose the skill. As each athlete becomes technically proficient in each component of a particular motor skill, the coaching staff begins introducing different forms of interference in order to supplement skill acquisition. This process continues until the practice of a particular skill evolves into a more open type of environment, where the skill practice develops into drills that are 100% game specific and perfect snapshots of that particular area of the game. This relates back to Magill's (1993), assertion that transfer from practice depends upon the extent to which practice resembles the game.

An example of this type of structure would be a 'pilfering drill', whereby the technical aspects such as body position, flexibility etc are initially addressed. However, as the athlete becomes proficient in this area, a reaction component is introduced. Then the athlete's game running lines are introduced etc. Finally, the drill resembles a game specific contact situation, where participants are practicing not only pilfering, but opposing skills such as technique and footwork into contact, defence, technical aspects of the clean out and ball-presentation skills, all in the one drill.

As can be seen from this type of drill sequence, contextual interference is introduced along the lines of Farrow's (1998), recommendations, to a point where it is extremely high. This type of contextual interference can be classified as intra-task interference (Shea et al, 1993), as it is reflective of one particular aspect of the game. This type of skill progression is reflective of other types of unit-type skills such as Lineouts, Scrums, and Backline play etc.

Whilst it has been established that at elite level, the use of general motor programming theory and high contextual interference practice methodology is utilized excellently within unit type practice.

Observations of Canberra Vikings training in 2001, a number of Sydney First grade trainings in 1999 and ACT Premier Division Club training's over the past four years has enabled the author to make the following conclusions. Training structure was predominantly in blocked format, whilst the technical components within unit skills were also practiced predominantly in a blocked, closed type environment, without progressing to drill situations that resemble the open nature of that area of the game. A typical club type-training format is illustrated in Table 2.

Table 2.

• Warm Up	20 min		
• Impact skills	20 min		
• Unit skills	30 min		
• Forwards		Backs	
• Scrum	15 min	Backline Starters	15 min
• Lineout	15 min	Counter-Attack	15 min
• Unopposed Team Run	30 min		
• Warm Down	5 min		

To illustrate the nature of training, the lineout session, for example, would consist of between thirty and forty lineouts performed one after the other in block fashion. Lineout variations are also often performed in blocked fashion. Athletes engaged in this type of session would have to enlist a similar type of motor program for each execution of each component of the session. However, this type of session is not 100% reflective of what would occur in a game, as a lineout would probably be followed by skills, which are encompassed within a different unit. Examples would include breakdown or defence, and subsequently, the next Set Piece play may be a scrum.

Further, an impact session is often practiced in a closed type of format, where groups of attackers may oppose groups of one to three defenders, set apart in a staggered line. Subsequently, the next time that the team practice impact could be in a fully opposed session, inclusive of set pieces, or in a competition game. As a result there is a huge leap from this closed-type practice to open environment competition. In this incidence, any improvements gained during the closed-type practice will not be realized during competition, as the motor cortex becomes overloaded by interference from other

aspects of the game. In these mental overload situations, technique is compromised. Further, each time a player executes poor technique, that neural pathway is reinforced. This is supported by Bortoli et al's (1992), conclusions. When it is considered that skill acquisition, from associative to automatic stage takes around 300 trials of identical quality, for an average index of difficulty skill.¹ Each time a skill is executed poorly, the process of technically correct skill acquisition is extended, whilst skill execution progresses towards the autonomous stage, utilizing poor technique.

In order to alleviate this, after skills are practiced in a closed type environment, they must then be executed in a more open-type environment. Further this must occur in conjunction with other skills that complement that area of the game, before players are exposed to all the components that comprise the entire game. I.e. the conjunctive skills might be catching under pressure before adjusting one's footwork to enable a player to effectively negotiate a tackle and support lines in order to execute an effective clean out.

Therefore, a more effective way to structure this type of impact session in order to encourage more transfer into the game, would be to begin the session in closed type format, similar to that mentioned above. This will allow players to effectively prime the correct technical motor programs. Then begin adding interference. For example, the subsequent impact may be structured so it resembled that which may occur after a First Phase move. In this case all players would occupy the positions that they would generally hold at set piece. Subsequently, during the execution of this, players are engaging the relevant motor programs which complement effective impact skills, i.e. catch/pass, footwork under pressure, and most importantly - realistic support lines. Also defenders should be encouraged to practice defensive lines, tackling and pilfering skills. Thereafter, the drill has altered in order that a number of different game-related skills are being practiced in the one session, thereby rendering it

¹ Personal Communication Patricia Denham-Mason, Senior Lecturer, Centre for Sport Studies, University of Canberra

more functional, game specific and linking practice better to the game. Practicing with this progression, rather than the initial scenario, will promote greater skill transfer to the game situation. The pertaining issue is 'specificity' - transfer will only be enhanced if the practice resembles that of game requirements.

Whilst it is clear that the use of Contextual Interference in the structure of training will enhance transfer to performance at sub-elite level. Is it possible to use Contextual Interference to further enhance transfer from Practice to Performance at elite level? Based on the findings of the literature reviewed in this paper the answer would be yes!

Whilst at elite level intra-task contextual interference is high, inter-task contextual interference (Shea et al, 1993) is actually quite low. Inter-task interference, for the purpose of this paper, can be defined as the interference between the unit components that make up the entire performance i.e. scrum/lineout/back-line attack etc.

Similar to the sub-elite session illustrated in Table 2, an elite training day consists of each of the unit components (i.e. scrum, lineout, impact, backline play etc.), that interact to compose performance being practiced separately and in Block format (in relation to other unit components) with low contextual interference. For example, a lineout session would again consist of between thirty and forty lineouts performed one after the other in block fashion. The nature of the motor programs selected would alter depending upon the intra-task contextual interference enlisted. This would usually occur by encouraging the random calling of structures and throws, and by including an 'opposed' element at some point during the session. However, during a game 30-40 lineouts aren't called consecutively, so

this is still not 100% reflective of what would occur, as subsequent to a lineout, skills relating to ball transfer, defence and impact are required to be executed.

Similarly, the Goal Kicking sessions observed at elite level consisted of each athlete executing around fifty kicks at goal, again in blocked format. However, this is still not reflective of what would occur in a game, as a kick at goal would follow a penalty, which would have resulted from an unrelated type of play (I.e. Defensive infringement, Off-side as a result of a break-down play etc). A recommendation for the practicing of goal kicking, to enlist more contextual interference, would be prior to the beginning of an unrelated session, to kick at goal for around five minutes in blocked format. Then during breaks in the subsequent session, the coach would randomly instruct the team's goal-kickers to execute penalty shots. Subsequently, the neural fatigue experienced during a game when a kick at goal is required, would be reflected in the training environment.

Consequently, based on the literature reviewed, in order to further maximize transfer from training to performance, it is recommended that, in conjunction with increasing intra-task interference, inter-task interference must also be increased, by practicing each of the unit-based components in random format. For example, a scrum session may be conducted in conjunction with a lineout session or further, a number of unit skills which would normally be practiced in isolated blocks could be practiced in the format of a circuit consecutively, similar to the example outlined in table 3:

Table 3.

• Forwards	Backs
• Combined Scrum/Lineout	3x Phases against defense
• Combined Impact/Defense/Passing & Running Lines	
• Folding Post defensive drill	4 Vs 7 slide defense
• Kick-Off Receipts - Defense/ Attack	Counter-Attack - Defence/Attack
• Ruck Touch First's Vs Seconds	
• Warm Down	

This circuit type session, similar to a generic format proposed by Farrow (1998), is a thirty-forty minute session, whereby players are practicing at least two different skills during each drill, before quickly moving to another drill on the sound of a whistle. The session needs to be performed at maximum intensity and each component practiced for between 2 and 3 minutes before changing. In this type of session, athletes are forced to load a number of different motor programs in relation to the changing nature of the drills being practiced all in the one short session. In relation to the literature reviewed, this type of training would have benefits in training the motor cortex to decrease reaction time in loading and execution of motor programs, whilst attaining functional overload of consigning a number of different programs consecutively. Further, functional overload in relation to neural fatigue is achieved. Finally, as long as the session is performed at **game like intensity**, executing each component in 2 – 3 minute blocks adds a repetitive practicing element, that is missing from full-contact game simulations.

All of these elements aren't currently being addressed by block-type/low contextual interference training structures.

CONCLUSION

It must be noted that this randomizing of practice shouldn't totally replace blocked practice. Blocked practice is especially important for novices, and at the beginning of pre-season when skills should be broken down into their cognitive components. It is also appropriate for the acquisition of new techniques, moves, and lineout throws etc, or for reinforcing technique acquisition, before progressing to open type training. However, as the neural pathways for correct technique execution are established, interference must be introduced, in the form of other components of the skill being executed, until that area of the game is being practiced in drill type situations that are 100% game specific. Then each of the various units must be practiced in an interference type situation in order to overload the neural capacities so as to promote better transfer into competition games. At present, particularly at club level, there is too large a jump from blocked type practice to game situations. Therefore, it cannot be expected that training in a closed type environment will produce great positive transfer into an open environment game. It is the coach's responsibility to assess the appropriate skill level of their athletes and prescribe training protocol effectively. The structure of drills & training particularly during the playing season should resemble:

- Closed component at beginning of unit session to prime the motor cortex, and to practice any tactical variations, or technique deficiencies
- Add selective interference before finishing the session in an opposed type practice that is specific to that area of the game

- Then practice each unit component in an interference type session which links all of the game components together
- Game simulation – opposed/semi opposed. (For example, fully opposed in body suits – set piece +3 phases or ruck touch)

The introduction of interference should occur in conjunction with Farrow's recommendations detailed in Table 1.

An example of a full club training session running for 1 hour and 45 minutes inclusive of warm-up and warm down, that utilizes all of the techniques reviewed in this paper is included in Table 4. With regard to the contextual interference session, it is pertinent that the athlete's do not know the timings of the drills, or which drill they will be going to next, as this will compromise the level of interference desired.

Table 4.

15 Mins	Ball handling and dynamic warm up		
25 Mins	Unit Skills:		
	Forwards:		Backs:
	Scrum:		3 Mins Unopposed 1 st phase starters
	1 Min Individual machine engagements		5 Mins Opposed 3 phases - 2-handed touch
	2 Min Team machine engagements		5 Mins Kick/Chase/Counter-Attack
	5 Min 1v1, 1v2, 2v2 live engagements		
	5 Min Live Scrums		
	Lineout:		
	3 Mins Unopposed - Blocked		13 Mins Combined – Opposed 3 phases & Kick/Chase/Counter-Attack - Random
	5 Mins Unopposed – Random high intensity moving to different spots on sideline		
	5 Mins Opposed - Random Attack/Defense high intensity moving up & down the field		
20 Mins	Impact		
3 Mins	Closed - 2 Vs 1		
5 Mins	1 st phase impact Vs 1 st phase defensive line		
5 Mins	Phase impact Vs phase defensive line		
7 Mins	Impact 3x phases		
35 Mins	Contextual Interference Session		
	Forwards:		Backs:
3 Mins	Combined scrum & Lineout		3x Phases Attack Vs Defense
30 Sec	Change		
3 Mins	Combined impact/defense/passing & running/support lines		
30 Sec	Change		
3 Mins	Folding Post Defensive drill		4 Vs 7 slide defense
30 Sec	Change		
3 Mins	Kick Off Receipts/Attack/Defense		Counter attack/kick chase/attack/defense
30 Sec	Change		
3 Mins	Ruck Touch 1 st 's Vs 2 nd 's		
30 Sec	Change		
3 Mins	Kick Off Receipts/Attack/Defense		Counter attack/kick chase/attack/defense
30 Sec	Change		
3 Mins	Combined Scrum & Lineout		3x Phases Attack Vs Defense
30 Sec	Change		
3 Mins	Ruck Touch 1 st 's Vs 2 nd 's		
30 Sec	Change		
3 Mins	Folding Post Defensive drill		4 Vs 7 slide defense
30 Sec	Change		
3 Mins	Combined impact/defense/passing & running/support lines		
20 Mins	Conditioning		
5 Mins	Warm Down		

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