CHALLENGING TRADITIONAL PRACTICE APPROACHES TO AFL KICKING SKILL DEVELOPMENT

Prepared by:

Prof. Damian Farrow

School of Sport & Exercise Science

Institute of Sport, Exercise, & Active Living

Victoria University

Skill Acquisition

Australian Institute of Sport

Email: damian.farrow@vu.edu.au

Introduction

This report was commissioned by the AFL Research Board as a result of the following series of questions being posed by AFL clubs in relation to kicking skill development.

1. Kicking Skill: How much improvement can be expected?
2. Can an average kick become a really good kick with intensive practice? How long might this take? If only, say, a %5 improvement is possible in players who come into the AFL systems as poor kicks, clubs might then be better off spending more time, energy and resources on other areas. If players haven't had (the generally quoted figure of) 10,000 hours of play practice as kids to really imprint and develop the skill of kicking, clubs may be wasting valuable time by trying to refine this skill at age 18-20?
3. What is the evidence that kicking is improved much past age 18 (Draft age)?
4. Is it easier to improve goal kicking than field kicking past Draft age?
5. Is it easier to improve the non-preferred than preferred side past draft age?
6. How much time is required to improve ... Is there any research that this can lead to injuries because they have to kick a lot to improve?
7. Is there any 'world best practice' research on teaching/learning to improve a kicking skill?
8. Is the improvement of field kicking due to correction of technique or just a matter of young players getting used to the pace of the AFL game?
9. Is the improvement directly linked with physical improvement of the player?
10. What about the issue of decision making on 'improvement' in field kicking? Decision making includes players knowing what they can/can't do with their kicks and sticking within their 'limitations' as well as players with 'good vision' being able to see the right option so appear to be better kicks than those who are perceived to be good technically but 'stuff it up' on competition day because they are 'poor decision' makers.

The above questions can be best addressed by consideration of a number of common themes underlying skill development. Specifically, the organisation of practice and provision of instruction / feedback are the most influential tools available to a coach trying to guide their player's skill development. This report will focus on how these key factors influence the learning of kicking skill. This report is not a recipe of drills for developing kicking skill, nor is it an exhaustive list of all the factors that influence kicking skill, but rather in the author's view, key factors that can assist practitioners working within an AFL high performance environment. The report also makes two other presumptions: 1) the player is genuinely motivated and wants to improve his kicking skill; and 2) that the coaching suggestions made are implemented in a systematic fashion over time and not simply trialled for a session and discarded because they didn't seem to work.

The report is organised as follows:

1) Recognising the Difference between Transient and Permanent Behaviour Change
2) Developing a Skills Coaching Framework Using a Constraints Model
3) The Key Skill Practice Tools
4) Common Misconceptions / Misinterpretations of Existing Theory
5) Direct Answers to the Club's Questions.

1) RECOGNISING THE DIFFERENCE BETWEEN TRANSIENT AND PERMANENT BEHAVIOUR CHANGE

One aspect of skill development that leaves all coaches uneasy is whether a player has genuinely learned the new technical component being coached, implying a permanent change in the player's kicking skill, or whether they have simply made a transient improvement that will disappear before the next practice session. This can be referred to as the *learning or performance* issue and understanding the difference between these terms and how they interact with different practice approaches is critical to successful skill development.

Learning is regarded as a permanent improvement in the capability to perform a skill as a result of practice, suggesting that some underlying mechanisms (e.g., muscle mechanics, nervous system control) have been developed. In contrast, performance is simply skill execution at a particular moment in time (not permanent). It can be highly variable and sensitive to conditions such fatigue, environmental conditions or coach instructions (see Magill, 2007). Quite often when focused practice is devoted to a particular skill such as the kick, rapid progress is seen over a session due to the strong feedback and practice emphasis provided by the coach. At the end of the session it is often concluded that the player has "picked up the skill really well" or "mastered that key component". Yet the reality is that they improved their performance of the skill, as a true assessment of learning cannot occur until a later training session when the impact of the coach's instruction and intensive practice has dissipated. For example, does the skill hold up in a game environment?

2) DEVELOPING A SKILLS COACHING FRAMEWORK

USING A CONSTRAINTS MODEL

For some time theorists (i.e., Newell, 1986; Davids, Button & Bennett, 2008) have discussed the influence of constraints on movement coordination and skill. The major tenet of their approach is that the dynamic interaction between the constraints of the task, environment, and performer lead to an emergent behaviour outcome (see Figure 1). Importantly, the influence of a specific constraint on a player's skill is not permanent and will be individualised dependent on the player's skill level, experience and development.

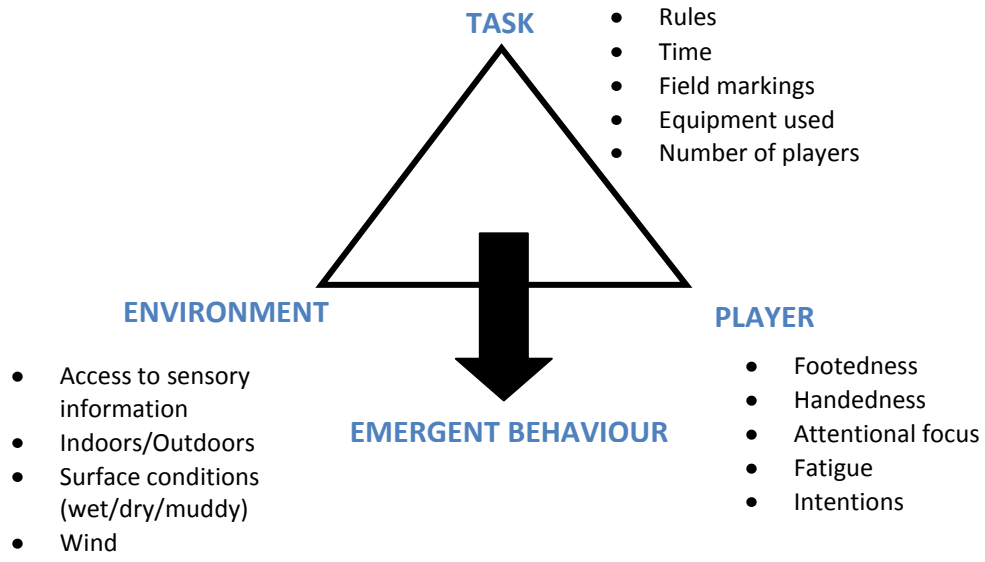

Figure 1. *A constraints based coaching framework (adapted from Newell, 1986)*

Task Constraints are the major constraints manipulated by a coach. These include the coach's choice of practice activities and include variables such as game rules, field markings, goals of a task/game, and the equipment utilised.

Environmental Constraints relate to the different playing and climatic conditions encountered. For example, playing indoors or outdoors, ground surface conditions and elements such as light, temperature, altitude, wind and rain. It also includes access to sources of sensory information such as auditory information e.g., a teammates calling, visual and kinematic information.

Player Constraints include physical, mental, attentional and emotional factors impacting on final performance. These include; customary patterns of thinking such as a player's typical intentions in a specific context e.g., always looks to play on, knowledge of team structures, body composition (height, weight), handedness and footedness.

Practice is considered to be the manipulation of the constraints of the player, the environment and the task (Newell, 1986). The role of the coach is to constrain the practice activity or game to an appropriate level of difficulty via an understanding of the variables that influence the progress of their players (See Table 1 as an example). It must be recognised that a change in any one of the above constraints can cause the emerging behaviour (skill production) to change. In summary, the coaches role is to:

- Manipulate the constraints
- Determine how to create practice that allows players to learn by themselves
- Guide and Shape rather than Dictate practice

This is a challenging style of coaching as you need to understand the skill demands well. Once an activity has been designed and implemented coaches need to be "more hands off", relying on skilful observation and player questioning to ascertain what the player's are learning (see Davids, et al. 2008 for a more complete coverage of this topic).

Constraints	Examples	Action Encouraged	Learned Outcome
TASK	**Ball Type**	Kick with a tennis ball, mini football, soccer ball, regulation football	Different challenges to player in terms of precision / adaptability. Focus attention on different elements of the kick eg; ball drop–foot contact
	Rules	Must kick within 2sec	Quick disposal
		Must kick off one step	Generate foot speed without running momentum
ENVIRONMENT	**Indoors low roof**	Impose a low, flat ball flight	Discover what aspects of kicking style need to change to meet environmental demands
	Outdoors cross-wind	Develop awareness of how to allow for wind conditions to hit target	
PERFORMER	**Instructions**	Listen to sound of contact	Learn to develop awareness of good vs bad contact

Table 1. *Examples of some constraint manipulations.*

Theory into Practice

Traditionally, coaching has viewed the task, performer and environment as variables that should be trained in isolation. For example, kicking is often practiced in drill situations where the coach fails to consider the nature of the environment where the skill will be performed. How often do we see kicking in pairs completed with no thought given to a preferred kick trajectory / weight for a particular situation. This "headless" practice is seen as a warm-up, giving the players necessary touch and feel. In reality, it's a wasted practice opportunity that will provide little transfer to the competition setting.

A Simple Alternative

A more thoughtful practice approach (for both coach and player) is one that considers the interaction between the player and their environment. Players may still kick in pairs (over 40m) but with the specific aim of attempting to flight the ball over the back of a team-mate as if he was protecting space behind. After a few minutes of such practice the coach may require players to now kick across the ground rather than up/down to experience the wind blowing in a different direction. Skilful observation by the coach may reveal that the kicker is not getting useful feedback when the drill is completed in pairs. As a result a defender is added to compete against the marking player so that the quality of a given kick can be more accurately assessed by the kicker. Obviously there are multiple kick types that could be simulated and further progressions possible. This simple example, highlights the important interaction between environmental and task constraints that can easily be manipulated by a coach to facilitate skill adaptability in their squad's kicking.

Developing Perfect Technique

In relation to the development of kicking skill, coaches should discard the strategy of verbally instructing players to produce an idealized technique in favour of *understanding how players can best discover* a specific movement solution that harnesses their unique intrinsic dynamics (Davids et al. 2008). One only has to consider the myriad of kicking techniques in Figure 2 (below) to appreciate the logic of the David's suggestion.

Figure 2. *Evidence that there isn't one kicking technique but a variety.*

It needs to be remembered when evaluating technique that coaches tend to do so with an optimal movement pattern in mind. However, research has demonstrated that even for highly stable skills, such as golf putting, common optimal coordination patterns don't necessarily exist (Fairweather, Button & Rae, 2002). The reason for this is twofold: 1) Each time a skill is executed it is done so under slightly different conditions, such as the time and space available to execute, ground conditions, wind, etc... and; 2) remember *performer constraints* – each player has different limb lengths, leg power, etc... that will have influenced the way they have developed a kicking pattern. If you agree and accept this to be the case then this has important implications for how to structure skill practice. Instantly, the focus needs to be one of encouraging adaptability in a players kicking skill rather than striving for some sort of perfect idealised technique that will never be found.

A practice and game analysis by David Rath of the Hawthorn Football Club highlight the importance of understanding the game and in turn manipulating the correct constraints in a practice context to generate transfer from practice to the game. Table 2 highlights the relative frequency (%) of particular characteristics linked to a player kicking the ball in a game relative to a typical training session. Looking at the disparity between the frequency of occurrence in a game relative to training it is not surprising that the ultimate measure of kicking skill (% of targets hit) is significantly lower in a game setting than training.

Characteristic	Game %	Training %
Source of kick from a mark	38	47
Source of kick from a handball receive	29	13
30-45m kick	44	28
Straight kick	88	31
Across body kick	19	67
0-1sec processing time before needing to kick	14	3
7-8sec processing time before needing to kick	38	67
1 step prior to kicking	13	0
2-4 steps prior to kicking	31	56
No use of evasive skills prior to kicking	32	86
Moderate perceptual load (amount of player density ahead)	74	19
Kick hit target	57	86
Kick missed target	35	14

Table 2. *Relative frequency (%) of various pre/kick characteristics in a game and training.*

3) THE KEY SKILL PRACTICE TOOLS

Practice Repetition Is Only Part of the Equation

Activity/Skill	Performer	Repetitions for Skilful performance	Basis for Estimate
Cigar Making	Young women	3 mill cigars	Crossman 1959
Football Pass	Quarterback	1.4 mill	15yr x 200d x 4hr x 2/min
Football Punt	Player	.8 mill kicks	200/day x 5 days x 45wks x 15 yrs
Baseball Throw	Pitcher	1.6mill throws	3/min x 80mins x 300days x 10 yrs
Netball Shot	Goal Shooter	598,000 shots	200d x 5 days x 46 wks x 13 yrs

Table 3. Estimated repetitions required for skilful performance (Adapted from Kottke, 1979)

Coaches know better than anyone that there is a positive relationship between the volume of practice completed and successful skill learning. However, as Table 3 highlights if repetition was all you had to rely on then a significant investment in time and physical cost to the players would be involved to reach a skilled level of performance. In this era where injury prevention is paramount, the ability of a coach to structure efficient practice, reducing the volume of repetition but generating appropriate skill learning is more important than ever. Thankfully, there are approaches to organising the practice repetitions available to maximise each kick completed.

Making Every Practice Repetition Count

How a coach organises and distributes practice repetitions within a session has a profound impact on how much learning occurs. While a popular coaching adage is 'practice makes perfect', skill acquisition practitioners have a different mantra, 'repetition without repetition'. In other words, it's not the repetition of an identical kick over each practice opportunity that generates learning, rather its practice approaches that force a player to adapt their technique to achieve a consistent outcome goal. Put simply, a player that has to think (not necessarily consciously) about how he is going to kick the ball to reach his intended target before every kick will generate greater skill learning than a player that only has to solve this problem the first time he kicks the ball in a drill after which time every kick is the same so minimal mental effort is required.

Theory into Practice

A classic study (Kozar et al. 1994) examining the basketball free throw shooting accuracy of an NCAA Division 1 men's team in practice and the game highlights the importance of making every repetition count. Players were found to shoot an average of 7-8 shots in a row each time they practiced the skill. Contrast this to the game setting where either 1 or 2 shots in a row are the norm. Practice free throw accuracy was 74.5%, compared with game accuracy of 69%. Of most interest was when the first 2 free throws in practice were analysed separately the accuracy was 69.8% or the same as game performance. This highlights the importance of spacing repetitions so they all count equally. It also highlights the importance of practice specificity or put simply, the amount of transfer from practice to the game will depend on how closely practice conditions resemble the game.

Whenever I read this paper I think of set shot goalkicking. Typically if it's practiced at all, it's done in blocks where players kick 10 shots in a row from the same spot or various positions around the goal-face, often without a man on the mark. From a practice specificity perspective wouldn't we expect better transfer if those same 10 shots were taken in 5 blocks of 2 kicks or 10 x 1kick (if well planned and time permitted) throughout a training session and with a man on the mark.

People unwittingly set up practice for success rather than setting up practice for learning (Guadagnoli, 2007)

The suggestion to encourage problem solving and adaptability can often be misunderstood. For many generations kicking practice has revolved around "lanework drills" where players repetitively practice the same kick. The drill is structured such that they are typically kicking from the same distance and angle, using the same ball flight on each kick repetition. Furthermore, there is usually little to no perceptual-decision-making component to the drill, as the player's lead toward one another with no defenders in sight. Such training is associated with performance success as players get the opportunity for high repetition and a chance to apparently "engrain the skill". Both coaches and players make this assessment because of how sharp the players look and how few targets are missed during the completion of the drill. Unfortunately this is a good example of a transient performance improvement rather than any permanent learning. It should be noted that such training does give players confidence, so it has its place if that is the coach's primary aim, but more on that below.

There is a long history of skill acquisition research that has examined this issue and found that even for relatively closed skills like goalkicking, it is valuable to expose a player to practice variability so they are required to problem solve and potentially adapt their technique to meet their task objective. An important issue associated with adopting a practice approach that forces the player to engage in active problem solving, rather than passive practice, is that it can often lead to highly variable skill execution and inconsistent performance outcomes within a given session. Many coaches perceive this inconsistency as a 'negative' and adapt the practice drills to remove the so called 'error', yet this is the very source of the advantage gained from variable practice. Learning is messy! The challenge for coaches is to determine an acceptable range of 'messiness' or what is termed 'functional variability'. That is, practice conditions that promote an acceptable learning rate where the player is suitably challenged but able to achieve the task goal. The accepted range of

variability may be narrower as the skill level of the performer increases. This can be called "Finding the Challenge Point" and is discussed in more depth later.

In short, well organised practice (that is, with sufficient variability and challenge) can actually reduce the required repetition. Practice variability can be created in many ways. One of the most well researched and successful method's is the application of a blocked or random practice approach or manipulation of what is called the 'contextual interference effect'. Contextual interference can be equated to the amount of mental effort a learner is required to use when practicing a sports skill. It has been found that the greater the mental effort a learner uses the better the resultant learning. Random practice involves alternating between two or more skills or variations on each practice attempt. For example, a player may perform one kick and then one handball and then repeat this process, kick, handball, and so on. Neither the kick nor the handball is practiced repeatedly by itself. Alternatively, blocked practice involves practicing one skill continuously for a set of practice attempts before practicing another skill. For example, all kicking repetitions are completed before performing any handball practice. Research has found that blocked practice leads to better performance of the skills in the short-term compared to random practice. This would seem logical due to a player being able to get into the 'groove' on a given skill during a practice session. However, when the skills are examined over the longer-term to determine whether the training performance is permanent, random practice produces improved retention or learning of the skill. This is again a good demonstration of the need to separate learning and performance effects to truly assess the value of a specific practice approach.

The reasoning behind these paradoxical effects where blocked practice leads to superior practice performance, but poorer learning than random practice, can be explained by the relative amount of mental effort generated by each practice approach. The need to constantly switch between different skills in a random practice schedule may create higher levels of mental effort than a blocked practice approach. The player is forced to more actively process the skill requirements **each time** they practice the skill, whereas in a blocked practice schedule the learner can 'switch off' after repeating the same skill a few times in a row. While the previous explanations make it clear that random practice generates more learning than blocked practice, the characteristics of an individual player and the purpose of a session, impact on the application of the practice schedule in a practical setting.

Theory into Practice

"Every night you go to sleep you may have something on your mind that you have to deal with. That shakes the box up and when you wake up the next day you're not the finished product anymore. The aim of every practice session, the reason I practice the way I do, is to find those pieces and, by the end of the session, to have packed them back in".

Johnny Wilkinson (English Rugby Union Kicker) describing his approach to kicking practice.

Finding the Challenge Point

The skill level and experience of a learner has been found to have a major impact on the usage of random or blocked practice. Specifically, beginners who have no experience or little skill in the tasks to be practiced will benefit more from blocked practice than random practice. It's argued that beginners need the opportunity to get an idea of the movement and establish a basic movement pattern before engaging in random practice. Blocked practice provides this opportunity as the learner can reinforce a desirable outcome or correct an error from the previous practice attempt without the interference of having to change to a totally different skill. This application seems logical if we consider the amount of mental effort a beginner applies to the learning of a new skill. To increase that effort by introducing a high interference practice schedule like random practice would only cause an overload on a beginner's limited processing capacity. However, once a basic movement pattern has been established the learner should then be exposed to a greater amount of interference so that the mental effort required is increased. Therefore, more skilled players generally benefit more from a random practice schedule than a blocked practice schedule. One qualification to this is that even skilled players who are attempting to learn a new kicking action or component may still benefit from some blocked practice initially to get the idea of the new technique.

Coaches should also be mindful that the practice schedule itself can be manipulated between the extremes of pure random or blocked practice. Although the research has typically investigated changing skills after every trial (random practice) or completing large blocks of trials on the one skill before changing (blocked practice), there are alternatives, some of which are summarised in Table 4.

No Challenge Equals No Learning. In his excellent book *Practice to Learn, Play to Win*, Mark Guadagnoli uses the analogy of Goldilocks and the Three Bears to explain the issue of finding the right Challenge Point. As the story goes, Goldilocks wanted porridge that wasn't too hot or cold, beds that weren't too hard or soft, rather they needed to be just right! Similarly, practice needs to challenge the player so that it's not too easy and requires little investment or too hard that it's de-motivating (Guadagnoli, 2007).

Drill / Activity Name	Description	Level of Interference
Block Trials	Instead of switching from skill to skill after 1 practice repetition do a small block of each e.g., 5 kicks then 5 handballs.	Low-Moderate
Variable Practice	Instead of switching between two totally different skills, practice variations of one skill. E.g., drop punt and torpedo.	Moderate
Win Shift – Lose Stay (Around the World)	Goalkicking Practice: If a player kicks the goal they *win and shift* onto a different kick location. If they don't kick the goal they *lose and stay* and repeat the same shot on goal.	Player generated difficulty based on current skill level
Skill Circuits	Don't get hung up in counting practice repetitions use time. E.g., 3mins practice at 4 different stations each focusing on a different skill (e.g., kick, ground-ball, handball, tackle).	Moderate depending on amount of time and number of stations in circuit
Practice-Rest	The secret to making every repetition count is to force the player to "forget" their previous practice repetition. Intervening between shots at goal and "having a chat" about an unrelated issue may do the job.	Moderate

Table 4. *Examples of how the amount of practice interference can be adjusted to suit the skill level of the player.*

Using Verbal Instruction and Feedback

The use of verbal instruction and feedback is the other most powerful tool at the disposal of a coach concerned with skill learning. Attention to detail in our usage of this medium is generally poor and often can be counterproductive to skill learning despite the coach's best intentions. This section will focus on a couple of the key issues namely, contrasting the application of Implicit and Explicit approaches and the provision of instructions that focus a player's attention either Internally or Externally. Finally, a brief summary is provided on basic feedback content and delivery guidelines.

Attempting to Coach More Implicitly

A major conundrum faced by coaches when attempting to convey technical information to a player is how to do it most effectively? Traditionally, the use of instruction to augment demonstrations and practice opportunities has been at the forefront of most coaching programs. However a growing amount of research investigating instructional techniques, specifically the role of explicit and implicit learning processes, suggests that the use of technical instruction in many cases may be unnecessary, and in some instances lead to skill degradation rather than enhancement.

Explicit learning can be related to traditional coaching approaches where verbal instruction is used to coach a learner about how to perform a skill. This process typically results in the learner hypothesis testing or evaluating each practice attempt. For example, "I released the ball as my kicking foot left the ground - that's good" and so on. As a result the player is able to verbalize how to perform the skill – although it doesn't guarantee they can physically execute the skill. In contrast, implicit learning methods typically contain little (or no) formal instruction about the skill mechanics, yet results in a player being able to perform the skill despite being unable to verbally describe how they do it.

Rich Masters and colleagues (see Masters, 2008) have been at the forefront of research investigating implicit learning. Overwhelmingly, the results of such work have demonstrated that learners (it's important to qualify that most research work has focused on learners not skilled players) coached using an implicit learning approach have learned equally as well to those instructed more traditionally. However, a number of additional advantages have been found for implicit learners relative to those who learn explicitly. Most critically, implicit learners are less susceptible to their skill breaking down in psychologically stressful situations relative to explicit learners who are more susceptible to what is commonly referred to as 'choking'. Explicit learners are more likely to preoccupy themselves with thoughts about how they are executing the skill, which when skilled is detrimental to performance and generally leads to 'paralysis by analysis'. Alternatively, those who don't have any technical information to refer back to, or hypothesis test, are unable to restrict their movement through over-analytical thoughts. Interestingly, this is a characteristic possessed by elite performers when 'in the zone' or playing at their best. Other advantages demonstrated for implicitly learnt skills are that they are more fatigue resistant, more durable over time, not attentionally demanding, and independent of age and IQ.

The relationship between the proposed benefits of an implicit learning approach and kicking skill development is most applicable to set shot goalkicking and is discussed in the next section.

Creating Implicit Learning for Goalkicking Practice

The basic premise underlying the design of implicit practice approaches is to develop activities that minimize or stop the learner from hypothesis testing, or simply thinking about what they did and didn't do correctly when performing the skill. A number of specific methods have been developed that meet this aim:

1) ***Explain the skill requirements by analogy or metaphor*** so that the need for explicit verbal information is minimized. For example, to describe the importance of a firm foot at contact you may relate this feeling to hitting a punching bag with a firm rather than sloppy wrist. If the metaphor resonates with a player the likelihood of skill retention is enhanced. If the analogy doesn't work think of another one that might. The most effective analogies are those that summarise a couple of key components relating to the execution of the kick.

2) ***Perform a secondary task while kicking.*** It is reasoned that attention to a secondary task precludes the opportunity for learners to reflect on the learning of the primary task (in this case kicking) and hypothesis test about how the skill is performed, preventing the opportunity for paralysis by analysis. For example, require the kicker to attend to a secondary task such as counting backwards in 3's from 100 out aloud while taking a shot at goal. Another popular approach is singing a favourite song out aloud while listening to your IPOD.

3) ***Utilize errorless learning conditions.*** Creating an environment where the learner is always successful prevents hypotheses-testing behaviour because no errors are made. Generally, if a player is not making errors they don't bother to over-analyse why. For example, practice kicking for goal at the distance and angle where it guarantees that the player will kick the goal 90% of the time. After a block of kicks from this position gradually progress the difficultly, always ensuring that they are successful the majority of the time. This approach may continue for a high volume of kicks or until a point in time where it is clear the player is no longer questioning/analysing every shot on goal. While this approach seemingly conflicts with the practice approaches discussed earlier, it is a useful strategy for a player in a slump or someone over-thinking their kicking.

4***) Provide no feedback to the learner.*** Based on a similar assumption to the errorless learning approach, creating an environment where the learner does not receive any feedback about their performance (specifically remove visual feedback) can also create implicit learning conditions. If you don't see what happened how can you test hypotheses? This somewhat controversial suggestion does have some practical support. When Tiger Woods was a boy he often practiced hitting at night on a naval base. Slightly more conventional was the massive volume of practice trials Jonny Wilkinson (English Rugby Union Kicker) accumulated kicking into a net located immediately in front of him. In both examples, the practice context removed ball flight information as feedback and perhaps decreased the amount of hypothesis testing (speculation of course but worth trialling).

A concern often expressed by coaches when first presented with implicit learning approaches is how could such processes work with more skilled performers who have already learned their skills in an explicit manner? The answer to this issue is twofold, firstly, no doubt an experienced player will always be able to verbalise aspects of the skill however the key is relegating these thoughts to the subconscious while performing. One method to achieve this may be to structure a high volume of implicit practice trials so that over time the player forgets all the explicit information concerning a skill's execution leaving the implicit processes to control the skill. The use of errorless learning or dual-task approaches as described previously are logical methods to try in this instance.

While it is acknowledged that explicit instruction is necessary on occasions, the aim of this section was to encourage coaches to think laterally and consider methods that reduce the reliance on explicit instruction and subsequently minimize some of the negative effects it can have on skill execution, particularly in competitive situations. Interestingly, implicit learning is usually how we learn many of our motor skills it's only been since the advent of coaching that we have disrupted this process. Watching infants and young children learn various sports skills reinforces this notion. Backyard footy games, with the myriad of different rules dependant on the backyard layout, ball type and size of the kids playing are a wonderful example of an implicit learning environment. Learning and adaptability occurs without any explicit instruction from a coach, rather the environment shapes the player's behaviour. The message here is that good coaches with imagination can still create implicit learning environments in a regular training setting. Explicit emphasis on learning skills through verbal instruction provides too narrow a focus for the player and does not permit them time to find their own solution to a movement problem. An implicit focus provides this opportunity. While time may be of the essence in the high-performance setting and it catchy to be able to say you are "fast-tracking skill development" the reality is usually somewhat different. Skill gains can be made quickly, but they are usually the one's that breakdown under pressure, costing you at the most inopportune times.

Internally or Externally Focused Instructions

Similar in approach to the usage of implicit or explicit learning approaches is the application of internal or externally focussed instructions.

Internally Focused Instructions: direct a player's attention to the movement of their limbs. For example, focusing a player's attention on their grip, ball drop, or aspect of the kicking leg mechanics.

Externally Focused Instructions: direct a player's attention to the effect of their movement on the environment. For example, focusing a player's attention on the ball flight after the kick, sound of the ball contacting the boot...

A large amount of research (see Wulf, 2007 for a review) has consistently demonstrated that focusing externally leads to superior skill learning relative to focusing internally. Potentially, for many of the same reasons as why implicit learning approaches possess some advantages over explicit learning approaches. One

reason for the advantage of external focus instructions and feedback is that they allow the player to discover and self-organise their skill and in turn support more effective learning and performance.

Feedback and Instruction

Feedback about a kicking repetition can be extremely valuable or totally counterproductive. Below is a brief summation of why.

- Providing additional instructions on how to perform a kick is not helpful if the player is naturally provided with goal-related feedback. For instance, if they can see the resultant ball flight and relate that back to the aspect of the kick they are working on.

- The challenge for the coach is to find ways to assist the player to link the outcome-related feedback (i.e., sound of ball contact, resultant ball flight etc...) with performance. For instance, if the ball comes off the boot with a "thud" rather than a "slap" you know you had a nice firm foot at contact.

- Providing players with detailed pre-kick instructions is usually too much information for the player to process and becomes redundant and distracting. Focus on one element of kicking skill at any one time. Ensure your feedback then only relates to this one aspect. Quite often coaches do a great job in only pre-instructing on one aspect of performance but can't help but give feedback on three different aspects.

- Despite its intuitive appeal, providing more frequent instruction, for example feedback after each kick completed, is also generally useless as it does not create permanent skill learning but rather short-term performance changes. The manipulation of feedback frequency is quite similar in concept to the processes responsible for the effects generated by random and blocked practice. If the player doesn't have to problem solve because the coach is feeding back information after each kick, the player quickly becomes a passive rather than active learner.

- The above suggestions all highlight the importance of the coach adopting a questioning approach to providing feedback (and instruction) rather than simply telling the player what they saw. It's good to get in the habit of starting any feedback with a player with the question "how did that feel?"; "what did you notice that was different from this kick to the previous one?" etc...

4) COMMON MISCONCEPTIONS / MISINTERPRETATIONS OF EXISTING THEORY

Deliberate Practice

There are many theories and “urban myths” centred on how much repetition is required for a skill to be learned. Anders Ericsson’s theory of deliberate practice (see Ericsson et al., 1993; Ericsson & Starkes, 2003) is an excellent example and is cited in question 2. Ericsson proposes that expertise in a given domain can be explained by the accumulation of ‘deliberate practice’ or the time spent performing a "well defined task with an appropriate difficulty level for the particular individual, informative feedback, and opportunities for repetition and corrections of errors.” Furthermore, it is suggested that 10,000 deliberate practice hours are necessary to reach expert status in the sport or skill practiced. Importantly, the 1st hour of practice should be as equally challenging / deliberate as 10,000th hour of practice. While Ericsson’s theory is sound, as there is no doubt that extensive deliberate practice is required and the notion that the 1st and 10,000 hours being equally challenging is appealing, there is still great debate on the specific nature of this practice (See Farrow et al. 2008 for more discussion). This theory has also been misinterpreted by many and it is commonplace to hear practitioners citing the need for 10,000 practice repetitions to become an expert performer. Irrespective of myth or reality, focus on such a theory only provides guidelines for the volume of practice required but doesn’t really assist coaches with the micro-planning of a practice session where the specific organisation and content of practice trials may actually generate different skill learning rates and subsequently alter the volume of practice required.

Skill Breakdown

Another practice issue where the established coaching convention and recent evidence may not be congruent is the issue of part-task practice or task de-composition. It has been promoted for many years that when a skill is high in complexity it is appropriate to break the skill into components and practice independently to reduce the attentional load on the player. After a period of time the components are then integrated back together as a whole. For example, it is common-place to see the ball drop practiced in isolation from the actual kick itself. For instance, players practice guiding the ball with one hand yet not having to drop it, or dropping it on a spot but not kicking it.

Recent research evidence suggests that a different skill is being practised using such approaches (Davids et al. 2001). For example, when the ball toss is isolated from the tennis serve, players typically toss the ball 20cm higher and with greater spin than they do when they actually hit the ball (Reid et al., 2010). Hence, despite best intentions it seems this type of practice is not actually assisting the player develop a better ball toss? Similar consideration is needed when evaluating the range of drills used for kicking development.

An alternative to this part-practice approach focuses on the notion of *simplification*, where practice simulates the natural performance conditions as closely as possible but key performance variables are reduced to simplify the task. To use the ball drop as an example, changing a task constraint such as the type of ball used may assist players work on guiding the ball down. A softer, perhaps slightly smaller ball may be easier for the player to control and may drop more slowly and hence the player encounters greater success guiding the ball down. Importantly, the ball is kicked in such practice. The logic behind the simplification approach is that skills need to be practiced more or less in their usual dynamic circumstances where the learner has to functionally integrate the typical perceptual and movement based information. To split this usual integration of information is analogous to the player learning two different skills (see Davids et al. 2008).

Gamesense or Skill Work?

A recent debate emerging in AFL coaching is the relative contribution of what is termed "gamesense" or decision making training compared to skill-based training. Many practitioners have seemingly set these two practice approaches at opposite ends of a continuum. This is nicely illustrated by this Herald Sun headline - "Buckley Calls for Return to Coaching Fundamental Skills" - http://www.heraldsun.com.au/sport/afl/nathan-buckley-calls-for-return-to-coaching-fundamental-skills/story-e6frf9jf-1225825241030

"We focus so much on gamesense and decision-making that you might miss the fundamentals at times" (Nathan Buckley). While detail in the article is limited, taken at face value I think Buckley's quote highlights a common misperception about the application of gamesense and fundamental skill training. The two practice approaches are not exclusive to one another. A skilled coach with an understanding of the key constraints would certainly be able to develop a "game", with appropriate challenge, where the focus is on fundamental kicking skill. It should be noted that the "gamesense" training approach starts with a focus on the player's learning how to play the game – or a focus on tactical awareness and decision making. However, it also explicitly highlights that if "technique" (fundamental skill) is the limiting factor to the game being played well then it becomes the focus of the game. Again there is ample research from other sports (e.g., Nevett & French, 1997) highlighting that physical skill is a significant limiting factor to decision making skill. For instance, a player who can't kick accurately over 40m but can over 25m is generally not going to look for decision making options presented outside his safe kicking range. Again it highlights the need to find the correct Challenge Point for a player. An appropriate fundamental skill game may involve kicking in pairs or 16 vs 16 – it depends. But in either case, the perceptual and action components are closely linked and not separated so that transfer is maximised.

This is a broader issue wrestled with by many coaches at senior level who struggle to find the balance between giving 1st year rookies adequate exposure to higher levels of performance to improve their skills yet excluding them from some training drills/games as their skills just can't handle the pace of the senior playing group. It's a delicate balance as some young players thrive in such settings whereas others will inadvertently drop the overall standard of training so much that the senior players (and coaches) become frustrated. Obviously there is no easy solution to this issue and a case by case decision is probably required.

5) ANSWERING THE CLUB'S QUESTIONS

In this section, headings and page numbers will be cited to cross-reference the content that addresses each specific question posed. In some cases additional comment is also included.

1. *Kicking Skill: How much improvement can be expected?*
2. *Can an average kick become a really good kick with intensive practice? How long might this take? If only, say, a %5 improvement is possible in players who come into the AFL systems as poor kicks, clubs might then be better off spending more time, energy and resources on other areas. If players haven't had (the generally quoted figure of) 10,000 hours of play practice as kids to really imprint and develop the skill of kicking, clubs may be wasting valuable time by trying to refine this skill at age 18-20?*
3. *What is the evidence that kicking is improved much past age 18 (Draft age)?*

I think questions 1-3 are essentially asking the same thing. Obviously there are a range of sections within the report that help provide some context to the answer (see pages 6-7, 8-12). Furthermore, this is as much an organisational issue as a learning question because unless the club is willing to devote the time and provide the practice conditions required (e.g., less competition in early stages of re-learning) any attempts would be futile. Three other points to consider:

1) There is limited published data specific to the issue of improving kicking skill past draft age. David Rath (Hawthorn Football Club) and Dr. Kevin Ball (Victoria University) both report objective data collected within high performance club settings that would suggest it is certainly possible given specific contextual conditions (eg; number of sessions / week, number of repetitions etc). For example, Ball reported that after a directed technical kicking programme that included increased kicking volume over the 2004-05 period, team goal kicking set shot accuracy progressed from 58% in 2003 (last in competition) to 68% in 2005 (first in competition). The volumes recorded for individual players ranged from a minimum of 80 kicks per week (player with injury history linked to kicking) to as high as 300 kicks per week in peak times for some players. In terms of the technical issues addressed it was found that ball drop correction was the most difficult facet to change whereas alteration in leg/foot mechanics and the support arm were easier to elicit change. Obviously, individual differences and player readiness to change would impact on these observations.

2) What non-AFL evidence is available? On this front we can refer to the famous examples of athletes such as Tiger Woods and Dennis Lillee who both successfully remodelled their technique despite performing at the elite level with a different technique (albeit we do not have objective data on how this was achieved).

3) There are a small number of studies that have attempted to address the issue empirically. Sanders (1995) deliberately examined Masters swimmer's who had used the same conventional breaststroke technique for at least 10 years and had reached a plateau in their performances to examine whether they could learn a new (wave action) technique. Swimmers completed 10 practice sessions of 45min duration delivered by a National coach over a 12 day period. They practised drills designed to elicit the new

technique (no detail of actual repetition was provided). Video feedback as well as vision of an expert model was provided to the swimmers on days 2 and 8. Results revealed significant changes in technique (kinematics), suggesting the swimmers had acquired the new skill, generally after the first 5 sessions. Progression was considered gradual rather than abrupt suggesting the swimmers modified their existing movement pattern rather than adopting a completely new one. This is an important point theoretically, as it has been argued by other learning theorists (see Zanone & Kelso, 1992) that the rate of learning is related to the extent to which the new technique cooperates or competes with the old movement pattern based on their intrinsic dynamics (coordination/timing profiles). If the patterns are similar, learning is faster than when a new pattern conflicts with the existing pattern. In cases of conflict, we see the performer become more inconsistent in their movement execution before any improvement occurs.

4. *Is it easier to improve goal kicking than field kicking past Draft age?*

This is an interesting question that can really only be speculated upon. My personal view is that set shot goal kicking does have the capacity to be improved more dramatically than field kicking because it has been practised less than field kicking. Hence, based on the Power Law of Practice (Newell & Rosenbloom, 1981) it is likely that a significant increase in practice repetition would provide substantial improvements in performance. Obviously if that repetition is completed according to the principles detailed in the report there is an even greater chance of success. For instance, manipulating key constraints in the practice environment such as the level of fatigue, spacing of the practice repetitions, ensuring there is a man on the mark, and adding pressure are all likely to provide favourable practice responses.

5. *Is it easier to improve the non-preferred than preferred side past draft age?*

Again little empirical evidence is available to directly answer this question. The concept of the Power Law of Practice would again be a factor as you would expect to see rapid progression early with an increase in practice devoted to the non-preferred side. However, would this acquisition result in a better performance outcome for a player than using the same amount of time/repetition to further refine his preferred side is a matter of debate. It would certainly be difficult to improve the non-preferred side to a level equivalent to the preferred side if significant non-preferred practice volume had not been completed pre draft-age. For some discussion on this topic for young children developing kicking skill in soccer see Teixeira and Teixeira (2008).

6. *How much time is required to improve ... Is there any research that this can lead to injuries because they have to kick a lot to improve?*

Consistent with previous comments/suggestions significant time is required, as is volume. There is a lack of objective data demonstrating the link between repetition and injury in AFL kicking (despite widespread anecdotal opinion!). Certainly if a player has a compromised physical state (e.g., poor core strength) and is asked to practice at volumes he is unaccustomed to then the chance of injury will increase. However, similarly a player who is progressed at a sensible rate based on their individual kicking and injury history

should find practice manageable and have no increase in injury risk. Obviously variables such as kicking distance and intensity all need to be considered.

The best source of related objective information on this issue can be gleaned from Cricket Australia's (CA) fast-bowling workloads research and subsequent policies. Due to concern of the prevalence of back injury, CA began to examine the issue prospectively. Dennis, Farhart, Goumas and Orchard (2003) found that compared to bowlers who averaged 123-188 deliveries per week, bowlers with an average of fewer than 123 deliveries per week or more than 188 deliveries per week were at an increased risk of injury. Such data suggests that not only over-bowling, but also under-bowling may also be an injury risk factor. Additional studies on a range of key issues such as age related issues and level of bowling intensity have also been commissioned and completed with further evaluation ongoing. Interestingly, in recent times there has been strong discussion amongst the State and National coaches that the workload guidelines need to be revised and individualised as it appears many bowlers are failing to progress as expected potentially due to not being able to bowl enough to develop their skill.

7. *Is there any 'world best practice' research on teaching/learning to improve a kicking skill?*
   Refer to the document as a whole.

8. *Is the improvement of field kicking due to correction of technique or just a matter of young players getting used to the pace of the AFL game?*
9. *Is the improvement directly linked with physical improvement of the player?*
10. *What about the issue of decision making on 'improvement' in field kicking? Decision making includes players knowing what they can/can't do with their kicks and sticking within their 'limitations' as well as players with 'good vision' being able to see the right option so appear to be better kicks than those who are perceived to be good technically but 'stuff it up' on competition day because they are 'poor decision' makers.*

    Questions 8-10 illustrate the holistic view needed for the development of kicking skill. The reason why many Skill Acquisition practitioners have adopted a constraints framework (see Section 2) is because it provides a logical way of ensuring all of the factors outlined in the questions above are developed appropriately. Evidence exists to demonstrate the reciprocal relationship between skill execution and decision making capacity (see Starkes, Cullen & MacMahon, 2004 for a review). Similarly, it is reasonable to expect a strong relationship between physical proficiency and kicking skill. A hallmark of skilled performers in many invasion sports such as Australian football, is their capacity to create the impression of having all the time in the world, when this is the case, kicking skill is likely to be more effective as the assembly of the kick is conducted under less stress. The challenge for coaches is identifying when a player's poor decision making is a reflection of their under-developed primary skills (e.g., kick) as opposed to a lack of knowledge about team patterns or lack of scanning/awareness.

Summary

The aim of this report was to challenge conventional thinking on how practice is organised in an AFL high-performance coaching environment. In particular, coaches need to be aware of the difference between short-term performance improvement and a true learning gain. Variable practice strategies are likely to require a player to engage more fully in the skill acquisition process and resultant learning is likely to be stronger. Coaches are challenged to say less (implicit learning approaches) and observe more so that the player becomes more active in the learning process, particularly learning to couple and adapt their kicking skill with the environmental conditions. Whenever possible it is preferable to keep the skill being practiced as a whole rather than breaking it into parts. It is important to note that the practice approaches discussed may lead to slower rates of skill acquisition than using some traditional coaching strategies. However, like many of the fine things in life, the process of skill acquisition should be given time to mature naturally for better long-term results.

In summary, to create learning you need PRACTICE THAT:

- Provides repetition
- Provides variability
- Increases cognitive / mental effort
- Optimises the challenge for the skill level of performer

You need to be uncomfortable in practice to be confident when it matters (Guadagnoli, 2007)

References and Further Reading

Davids, K., Kingsbury, D., Bennett, S., & Handford, C. (2001). Information-movement coupling: Implications for the organisation of research and practice during acquisition of self-paced extrinsic timing skills. *Journal of Sports Sciences, 19*, 117-127.

Davids, K., Bennett, S., & Button, C. (2008). *The Dynamics of Skill Acquisition*. Human Kinetics.

Dennis, R., Farhart, R., Goumas, C., & Orchard, J. (2003). Bowling workload and the risk of injury in elite cricket fast bowlers. *Journal of Science and Medicine in Sport 6*(3), 359-367.

Fairweather, M., Button, C., & Rae, I. (2002). A critical examination of motor control and transfer issues in putting. In A. Cochran, M. Farrally, & E. Thain (Eds.), *Science and Golf IV* (pp.100-112). London: Routledge.

Ericsson, K. A., Krampe, R. T., & Tesch-Römer, C. (1993). The role of deliberate practice in the acquisition of expert performance., *Psychological Review 100*(3), 363-406.

Ericsson, K.A. & Starkes, J.L. (2003). *Recent Advances in Research on Sport Expertise*. Champaign, IL: Human Kinetics.

Farrow, D., Baker, J., & MacMahon, C. (Eds.) (2008). *Developing Sport Expertise. Researchers and Coaches Put Theory into Practice*. Routledge.

Guadagnoli, M. (2007). *Practice to Learn. Play to Win*. Ecademy Press.

Handford, C., Davids, K., Bennett, S., & Button, C. (1997). Skill acquisition in sport: Some applications of an evolving practice ecology. *Journal of Sports Sciences, 15*, 621-640.

Kozar, B., Vaughn, R.E., Lord, R.H., & Whitfield, K.E. (1994). Basketball free-throw performance: Practice Implications. *Journal of Sport Behavior, 18,* 2, 123-129.

Kottke, F.J., Halpern, D., Easton, J.K.M., Ozel, A.T., & Burrill, C.A. (1978). The training of coordination. *Arch Phys Med Rehabiliation, 59,* 567-572.

Magill, R.A., (2007). *Motor Learning and Control: Concepts and Applications*, 8th edition. New York: McGraw-Hill.

Masters, R. (2008). Skill learning the implicit way – Say no more! In D. Farrow, J. Baker, & C. MacMahon (Eds.), *Developing Sport Expertise. Researchers and Coaches Put Theory into Practice*. Routledge.

Nevett, M., & French, K. (1997). The development of sport-specific planning, rehearsal, and updating of plans during defensive youth baseball game performance. *Research Quarterly for Exercise & Sport, 68*(3), 203-214.

Newell, K.M. (1986). Constraints on the development of coordination. In M.G. Wade & H.T.A Whiting (Eds.), *Motor development in children: Aspects of coordination and control* (pp. 341-360). Dordrecht, Netherlands: Martinus Nijhoff.

Newell, K.M & Rosenbloom, P.S (1981). Mechanisms of skill acquisition and the law of practice. In J. R Anderson (Ed.), *Cognitive skills and their acquisition* (pp. 1-55). Hillsdale, NJ: Erlbaum.

Rath, D. (2008). *Kicking load analysis: Comparison of kicking loads from games to training*. Research report, Hawthorn Football Club.

Reid, M., Elliott, B., Whiteside, D. (2010). *Effect of task constraints on tennis serve performance*. Internal Report, Tennis Australia.

Sanders, R.H. (1995). Can skilled performers readily change technique? An example, conventional to wave action breaststroke. *Human Movement Science, 14*, 665-679.

Starkes, J., Cullen, J., & MacMahon, C. (2004). A life-span model of the acquisition and retention of expert perceptual-motor performance. In A. M. Williams & N. J. Hodges (Eds.), *Skill Acquisition in Sport: Research, theory and practice*. London: Routledge.

Teixeira, M.C.T., & Teixeira, L.A. (2008). Leg preference and interlateral performance asymmetry in soccer player children. *Developmental Psychobiology, 50*, 799–806,

Wulf, G. (2007). *Attention and Motor Skill Learning*. Human Kinetics.

Zanone, P.G., & Kelso, J.A.S. (1992). Evolution of behavioral attractors with learning: Nonequilibrium phase transitions. *Journal of Experimental Psychology: Human Perception and Performance*, *18*, 403-421.