

Chapter 7: Skill acquisition

by Damian Farrow

One of the most alluring aspects of watching the best sportspeople in action is that they make the skills of their sport look easy — almost within reach. On occasions, the ease of the elite is enough motivation for the rest of us to get out on the court and give it a go. ‘Geez, if the Australian netball shooter can average about 90 per cent shooting accuracy, I must be able to average at least 70 per cent!’ Within minutes of making a few awkward shots at the local school courts the reality sets in, ‘This is harder than it looked on telly. There is so much to think about. How did she hold the ball again? How do I shoot it over the defender’s arm?’ Skilful performance is about developing a sound technical action and then being able to apply it under the pressure of competition.

This chapter is divided in three sections:

- . examination of what elements are required to make a skilled movement
- . discussion of some of the key characteristics in developing a coaching approach to assist in skill learning
- . the core principles of designing a successful practice environment.

Elements of a skilled sports movement

Perception and decision-making

Perception is the process of an athlete determining what is occurring both in relation to their environment (for example, ‘Where are my opponents and team-mates?’) and what is happening in their own body (for example, ‘How puffed am I?’, or ‘Where is my left arm relative to my right?’).

Decision-making is closely linked to perception and is about using the information gathered from perception to determine what, if any, response is required. For example, an athlete may have noticed that there were two team-mates in front of goal and only one opposition player. Decision-making is then used to select the next course of action; in this case, deciding to pass the ball to one of the two free team-mates while they out-number the opposition. While the two processes are different, it is useful to consider them together when looking at the implications for coaching.

In order to develop perceptual skills, it is important for the coach to understand what parts of perception are vital to improved sports performance and what elements are not so important.

Sports or situations where an athlete has little time to respond and react provide an excellent example of the value of perception. For example, interceptive skills such as cricket batting or defending a penalty kick in football all require athletes to initiate their response under severe time stress and initiate their movement before the ball has been hit or kicked. This is called anticipation, or the capability to start their response to an opponent's action in advance.

In team sports, perceptual skill is shown by an athlete's ability to 'read the play'. In skill acquisition terminology this ability is called 'pattern recognition'. Watching a team sport such as netball is a good example of watching a continuously changing pattern. While the pattern may look meaningless to the untrained eye, that is, 14 athletes sprinting and dodging in all directions, to an expert player (or coach) it can all look completely logical and allows them to predict in advance where the ball is about to be passed and helps with decision-making. This ability to recognise an opposition team's attacking or defensive patterns is not because the elite athletes have a bigger memory capacity than less-skilled athletes. Rather, their memory of sport-specific attack and defence strategies is simply more detailed and can be recalled and used in a split second.

Case study

Madeline coaches an under-17 state netball team. She is keen to do some testing of the players' pattern recall ability, as some of the players in the team often make poor choices about who to pass the ball to. Madeline videotapes a national netball league game, which was broadcast on television, to show to the players. She also prints up some blank netball courts on pieces of paper for the players to use. Madeline plays back approximately ten seconds of play and then quickly stops the tape and asks the players to try and recall where each player was positioned at the instant the tape was stopped, by marking the position of each player on the blank netball courts. The team in possession of the ball was indicated with an 'O' and their opposition with an 'X'. To check the players' accuracy, she then replayed the video sequence, but this time paused the tape and asked the players to check if it matched their drawing.

Madeline did this activity initially with a variety of set piece situations that occur in a netball match, such as a centre pass, or throw in from the defence end to the centre. She was aware that research has found national-level athletes can recall approximately 70 per cent of all the athletes seen. She found that there were some players who were unable to identify even 50 per

cent of the players in the picture. This assisted her in developing some game-based training activities to try and work on the players' perceptual skills.

Training perceptual and decision-making skill

Coaches should start by developing a check list of any key movement pattern information sources that may help predict what an opponent is likely to do in their sport. For example, rugby union coaches often cite the importance of watching an opponent's hip movement when preparing to tackle them. Most importantly, athletes should be coached to understand the relationship between the various movement pattern characteristics and the likely resultant player movement or ball direction. The use of video footage shot from the player's perspective (for example, a tennis serve filmed from the perspective of the receiver) which is then paused at various points before contact, is a useful means of training an athlete's understanding of movement patterns.

Another good information source is probability information such as an opponent's favourite kicking side, dodging direction or service location. This source of anticipatory information is vital at the elite level and requires close examination of an opponent's behaviour in different situations in order to identify particular idiosyncrasies or tactics used for disguise. Video review of particular opponents is the most common means of sourcing this type of information.

From a team-sport perspective, while there will be always be players who are more naturally talented than others, coaches can still improve an athlete's ability to read the play and make better decisions. The most important method is by using practice activities or drills that require athletes to continually make the decisions they will be required to make during competition. Too often coaches try to control practice by using drills that force the athletes to complete pre-programmed movements around a series of cones, with little or no decision-making required by the player. The more game situations that athletes get to experience, the more accustomed they will become to specific attacking and defensive strategies, and they will develop an understanding of where they should move to receive the ball or to whom they should pass the ball. This is why a game sense coaching approach is so valuable.

Case study

Danny is the coach of a developmental Australian football program in a regional area that has a high Indigenous population. His club has strong links with one of the major AFL clubs, which has recruited a number of young Indigenous players from his program. While Indigenous people make up only 2 per cent of the general population, they represent over 7 per cent of the athletes

competing in the AFL competition. More impressive is that the 7 per cent within the AFL are generally considered part of the competition's elite athletes.

Danny is aware that there are a number of factors that contribute to this phenomenon, such as the Indigenous player's physiological qualities being ideally suited to the game. However, he has consulted with a number of experts regarding some of the skill acquisition reasons behind this. Research has found that the best decision-makers in Australian football generally share similar developmental backgrounds. In addition to playing Australian football, these athletes all played a significant number of other 'invasion' games such as basketball, football and rugby union. They also spent significantly more time playing unstructured invasion games or, put simply, neighbourhood or backyard games/scratch matches such as '2 on 2' basketball or touch football. These types of activities develop the perceptual and decision-making skills of these athletes, allowing them to 'get a jump' on others who invest less time in such activities, but still end up making it to the elite Australian football competition, most likely because of their physical capacities.

As a result of this information, Danny ensures that his coaching program for young players (both Indigenous and others) includes a wide variety of game-based activities, and also includes activities from other sports. For example, he uses a touch football game as part of the warm-up, and a netball activity as part of his training session.

Action: skilled movement

The most obvious element to spectators watching sport are the movements of the athletes. Producing a skilled sports action consists of a complex mix of muscle control and timing. When comparing highly skilled athletes to lesser-skilled athletes, a number of movement qualities become apparent. In particular:

- . in sports where speed is important, the highly skilled are faster
- . in sports where movement timing is important, the highly skilled have more consistent movement times
- . in sports where reproducing the same skill repeatedly is critical to success (such as in golf or gymnastics), the highly skilled have greater consistency in both their movement and the timing of these movements

- . skilled athletes' efficiency of movement (movement economy) is superior to the lesser skilled. In other words, the skilled athlete can achieve the same outcome with less energy expenditure than their unskilled counterparts
- . as the basic skills of a sport become automatic to the highly skilled athlete, they are more capable of not only performing the basic skill (for example, dribbling the basketball) but can also give their attention to other aspects of the skill (for example, looking for a teammate to pass the ball to).

Sometimes it is difficult for a coach to know how automatic an athlete's skills have become. It is valuable to have this information, as it can assist the coach to decide when to progress the difficulty of a drill or game. The more highly skilled an athlete becomes, the more likely it is that they can perform the basic skills of the game automatically and also complete a secondary task simultaneously. Based on this, coaches can make a quick assessment of an athlete's skill by using an activity that requires more than one task to be completed. For example, the coach may set up a course through which the player can dribble the ball as quickly as possible. At the same time the coach will flash up a series of coloured cards at the end of the course and ask the player to call out the colour of the card when presented. The more-skilled athletes will be able to maintain their dribbling speed and control while accurately identifying the colour of the cards flashed before them. Lesser-skilled athletes will have to compromise on one or both of these tasks.

Developing a coaching approach

Catering to the individual: using learning styles for communicating with athletes

In a coaching setting athletes generally gather information either visually, aurally, through reading/writing or feeling/doing, or a combination of all of these methods. Identification of an athlete's learning style allows a coach to understand their preferred way of gathering, organising and thinking about the information given to them. Each athlete has a different learning style that, if catered to, allows them to absorb information to their full potential and maximise learning. An athlete's learning style can be identified either simply, through questioning and observation of how the athlete tends to learn during training, or through a formal questionnaire that can be administered (for example, see the learning style questionnaire at www.vark-learn.com/english/index.asp). The following table contains a summary of the key characteristics of each learning style as defined in the VARK learning style approach. This is only one of many

methods of defining a person’s learning style. Irrespective of which approach a coach adopts, the aim is to try and cater more specifically to their athletes’ learning needs.

Table 7.1: VARK learning styles

<p>Visual learners</p> <p>Prefer information presented visually (Note: images that contain movement, such as video, are not part of the visual learning style)</p> <p><i>High visual learners</i> — prefer information presented through graphs, charts, mind maps/flow charts and images, and also through changes in colour, font style, font size, highlights and boldness</p> <p><i>Low visual learners</i> — find it difficult to get meaning from images or symbols (for example, whiteboarding of team patterns)</p>	<p>Auditory learners</p> <p>Prefer information presented aurally, which is either through listening to others, or talking themselves. Interestingly, this would often be a coach’s most dominant method of communicating with their athletes</p> <p><i>High auditory learners</i> — like discussion groups, questions for coaches or other athletes, audio recordings to listen over key points, and also cue words they can say in competition</p> <p><i>Low auditory learners</i> — do not rely on what the coach says. They often forget important topics raised in team discussions, and miss highlighted points and lose concentration in long meetings</p>
<p>Read/write learners</p> <p>Prefer information presented through written words</p> <p><i>High read/write learners</i> — learn best through lists, headings, written cue words/phrases, others writing on same sport topic (that is, biographies)</p> <p><i>Low read/write learners</i> — do not use lists or place any emphasis on words. They lose or forget to bring any given sheets/papers to training or meetings and are reluctant to use training diaries</p>	<p>Kinesthetic learners</p> <p>Prefer information presented within action and movement</p> <p><i>High kinesthetic learners</i> — learn best through demonstration through movement, doing the activity, hands on, learning by experiencing, video feedback and visualisation</p> <p><i>Low kinesthetic learners</i> — distrust things learnt from experience and find that trial and error is not scientific enough</p>

Many athletes do not have one learning style preference, but possess a combination of preferred styles. In these cases, a coach needs to provide the key information in more than one method before the athlete is likely to ‘get it’.

Explicit and implicit learning approaches

How to convey technical information to an athlete most effectively is a major issue faced by coaches. While catering to the athletes' individual learning styles is one method for addressing this issue, another way is to consider the overall learning approach to take with the athletes. Traditionally, the use of instruction in conjunction with a demonstration has been a coach's main approach. However, a growing amount of research investigating instructional techniques suggests that the use of technical instruction in many cases may be unnecessary, and in some instances lead to a worse performance.

Explicit learning refers to traditional coaching approaches where verbal instruction is used to coach a learner about how to perform a skill. This process usually results in the learner evaluating each practice attempt. For example, 'I hit the ball in the air, I'd better adjust my grip' and so on. As a result the player is able to verbalise how to perform the skill — although it does not guarantee they can physically execute that skill.

In contrast, **implicit learning** methods contain little or no formal instruction about the skill mechanics, yet result in a learner being able to perform the skill despite being unable to verbally describe how they do it.

Interestingly, research has demonstrated that learners coached using an implicit learning approach learn equally as well as those instructed more traditionally. However, a number of additional advantages have been found for implicit learners, including being less susceptible to their skill breaking down in stressful situations, commonly referred to as 'choking'. Explicit learners are more likely to think too much about how they are executing the skill, which can be detrimental to performance and generally leads to 'paralysis by analysis'. Implicit learners who do not have any technical information to refer back to are not restricted by over-analytical thoughts. Interestingly, this is a characteristic possessed by elite athletes when 'in the zone' or playing at their best.

There are a number of implicit learning methods that can be used during practice. The aim of implicit practice is to develop activities that minimise or stop the learner from thinking too much about what they did or did not do correctly when performing the skill. Following are some approaches that have been developed that meet this aim:

- Explain the skill requirements by analogy or metaphor — this means that the need for explicit verbal information is minimised. Cricket coaching is littered with good examples of analogy learning. For example, asking athletes to shape their arms and bat to form the

number '9' overcomes the need for a number of individual instructions when coaching the basic batting set-up position.

- . Perform a secondary task while performing a primary skill — giving attention to a secondary task reduces the opportunity for learners to think too much about the primary task and over-think about how the skill is performed. For example, counting backwards in threes from 100 out aloud while dribbling a hockey ball.
- . Utilise errorless learning conditions — creating an environment where the learner is always successful prevents over-analytical behaviour because no errors are made (for example, goal-kicking in football from a distance and angle that always guarantees that the player will kick the goal). This approach may not suit every situation, but could be particularly useful for an athlete in a slump.

What goes through an athlete's mind as they prepare to execute a skill that has been practised many times before? When standing with the ball in hand, 40 metres out directly in front of goal, what does an Australian footballer think about — perhaps how they should swing their leg back to generate the required power, or perhaps they focus on the outcome of the kick?

Of interest to coaches is whether goal-kicking success rates are related to what athletes focus their attention on as they execute the kick. A flurry of sports science research over the last decade has tried to address this issue by examining what the optimal strategy is for focusing an athlete's attention as they practise and perform the skills of their sport.

Essentially, two types of attentional focus have been examined. An **internal focus** of attention occurs if the player's attention is directed to their body movements, such as focusing on guiding the ball onto the boot when kicking. Attention directed to the effect of the movement, such as the flight of the football, is called an **external focus**. Learning and subsequent performance of a skill is generally found to be superior if the player has adopted an external focus of attention. The logic behind using an external focus of attention approach relates to the old coaching chestnut 'paralysis by analysis'. Due to the amount of practice an elite athlete has devoted to their skills, they generally can perform the skill automatically without conscious effort. To use an internal focus of attention that forces the player to focus directly on the movement disrupts their normal unconscious skill processing. A similar explanation has been proposed as a reason for athletes choking under pressure — conscious thought about a movement turns the muscle memory of an elite performer into that of a novice.

Interestingly, when an athlete is kicking poorly, coaches generally try to improve performance through technical instruction, usually internal in focus. To convince athletes and coaches to make a change to an external focus of attention requires examples from other successful athletes, and the strongest support for such an approach is the performances of a famous English rugby union goal-kicker.

When the player was having problems with his kicking, it was decided to forget about technique (internal focus) and focus on 'Doris'. Basically, every time he prepared to kick, he externally focused his attention on an imaginary woman called Doris sitting in the stands behind the goalposts. Initially his focus was to hit her, and then as his skill level increased, he narrowed his target to kicking a newspaper out of her hands, and then a soft drink can. The results of this technique were significant.

Teaching and learning sport skills

When designing a learning environment for the practise of skills there are a number of important features that need to be considered by the coach. Following are some of the more vital characteristics.

Learning and performance

One of the most critical distinctions a coach can make is whether the focus of practice is on performance or learning. Performance is a skill execution at a particular moment in time. It is highly variable and sensitive to other conditions (for example, fatigue, environmental conditions, instructions). In contrast, learning is a permanent improvement in skill that is achieved as a result of practice. It is not necessarily a change in performance, rather an improved capability to perform a skill. Coaches need to understand that certain practice approaches and instructions only have an impact on performance (short-term improvement that is not retained) whereas other approaches are more likely to lead to longer-term skill learning. While both performance and learning approaches have their place in coaching, it is important that the coach understands which one will be developed in a particular practice drill.

Practice volume

There is a strong link between the time spent practising a skill and improvement in the performance of that skill. Research into the effects of prolonged practice and the rate of learning typically show that rapid skill improvements are made during the initial periods of practice, and

further improvement requires the athlete to invest in progressively more hours to accrue progressively smaller improvements. Put simply, we cannot practise our skills enough and generally the availability of time, and factors such as fatigue, reduce practice volume. Consequently it is important for coaches to structure practice volume so that athletes get maximum value for each repetition.

Practice variability and specificity

One way to organise practice is through the use of a random or blocked practice approach. Random practice involves changing between two or more skills or skill variations. For example, netball practice might involve an athlete completing a chest pass then a shot at goal, another chest pass and shot at goal, and so on. Neither the chest pass nor the shot at goal is practised repeatedly by itself.

Alternatively, blocked practice involves practising one skill continuously for a set of practice attempts before practising another skill. For example, 50 practice shots at goal are completed before performing any chest passes. Research has found that, compared to random practice, blocked practice leads to better performance of the skills in the short term. This would seem logical due to athletes being able to get into the 'groove' of a given skill during the practice session. However, when the skills are examined over the longer term and in the game setting (the ultimate test), random practice produces improved retention or learning of the skills practised.

So why does random practice cause poorer practice performance but lead to more effective game performance than blocked practice? It has been suggested that changing between two or more skills (for example, chest pass and shooting) results in the learner having to forget one skill to perform the other. Therefore when you attempt to perform the skill for a second time athletes have to try to remember what they did the first time and so on. Random practice requires greater mental effort on the part of the learner than blocked practice, whereby you repeatedly practise the same skill, not necessarily having to remember what you did previously. The key point is that the learner must not be allowed to go into 'auto-pilot mode' while learning a skill. As a famous football coach once said, 'I like my athletes to bring their brain to training'.

While random practice creates better learning than blocked practice, there are some exceptions. The skill level and experience of a learner has a major impact on the success of random or blocked practice. Beginners who have little or no experience in the skill to be practised initially benefit more from blocked practice than random practice, as they need the opportunity to get an

idea of the movement and establish a basic movement pattern. This is logical if we consider the amount of mental effort a beginner uses when first learning a new skill. To increase that effort by introducing the learning of two new skills at the same time, as in random practice, would only cause an overload on a beginner's limited attention capacity. However, once the basics are mastered an athlete should attempt to practise more than one skill in a session so that mental effort is increased. Therefore intermediate and advanced-level athletes can benefit more from random practice than blocked practice.

It is also important to consider the type of skills being practised when using blocked or random practice. Open skills are performed in an unpredictable situation generally under time-stress from an opponent, whereas closed skills are performed in a stable and predictable environment with no time-stress from opponents (taking a shot at goal with defenders removed). When using a random practice approach with open skills, it should be remembered that performing an open skill is more complex than executing a closed skill due to the additional demands imposed on an athlete, such as decision-making and time-stress. Therefore, random practice may need to be introduced at a later stage of development for open skills compared with closed skills, as the learner will already be experiencing a high degree of mental effort.

It should also be remembered that team sports are made up of a collection of skills that are used in all manner of combinations. When thought of in this manner it is easy to see that random practice more closely resembles playing the actual game than blocked practice. Equally important is that the benefits of variability apply to closed skill activities such as gymnastics. While the athlete may wish to reproduce the same movement each time, there are always variations that need to be handled. As such, designing training activities that develop the athlete's capability to handle such variation is best achieved through random practice.

Case study

Lara is a tennis coach who works with several talented young players. One of the players that she coaches, Claire, is a skilled technical player, with a powerful serve and a lethal backhand. However, she has poor anticipation skills, which seem to stem from her inability to 'read' her opponent's movements. This is a particular problem when she is returning serve, as she is often unable to pick where the ball is going early enough to anticipate where best to move to receive it.

Lara decides to use several new practice activities to assist Claire in developing better anticipation skills. She focuses on game-based activities, including returning of serve and when

to move to the net to volley, where Claire is forced to anticipate. By exposing Claire to these activities, which mimic a match situation, Lara sees an improvement in Claire's anticipation skills.

Practice strategies to simplify complex skills

A common challenge faced by coaches when designing practice is to make the activity achievable for all participant skill levels. This challenge can be particularly difficult when the complexity and organisation of the skills to be practised are considered.

Complexity relates to the number of components that make up a skill and its information processing demands. Skills such as a tennis serve, which has a large number of components and demands a large amount of attention, is a high complexity skill. In contrast, completing a bench press in the weights room is lower in complexity.

Organisation refers to how closely linked the temporal and spatial components of a skill are. Again using the tennis serve as an example, the link between the ball toss and subsequent racquet swing to contact are highly organised, whereas learning a variety of movements for a dance or aerobics routine may be less organised.

Following are some guidelines to assist coaches when deciding on how to simplify the presentation of a new skill to assist a learner.

- . If a skill is low in complexity and high in organisation, practice of the whole skill is recommended.
- . If the skill is high in complexity and low in organisation, breaking the skill into components or parts is appropriate. It is important to note that the parts of the skill should be put back into the whole as quickly as possible.
- . Unfortunately many skills fall between the previous two general rules and require greater analysis of a skill's demands. In such cases it is preferable to refrain from breaking a skill into components if at all possible. Reducing a skill's difficulty through simplification can be of value. For example:
 - slowing down skill execution — many coaches get their athletes to slow down their execution of the skill in order to gain more control. Such an approach is appropriate as long as the action is not slowed so much that the dynamics of the skill are completely changed. It must be remembered that reflexes play an important role in skill execution and are not recruited correctly if the skill is practised too slowly

- reducing the difficulty of the objects used to complete the skill — for example, using decompressed tennis balls for younger tennis athletes slows down the ball's flight and bounce height, making the task of preparing a return stroke a little easier than it would have otherwise been
- reducing the attention demands of the skill without changing the actual goal — these approaches are successful because they reduce a skill's complexity. For example, teaching a learner how to bowl a cricket ball may require the coach to start with no run-up component within the delivery action.

Summary

Developing a coaching approach that allows athletes to apply their skills successfully in a competition setting requires an understanding of a variety of skill acquisition principles. This chapter was designed to increase coaches' understanding of the perception, decision-making and action elements required to make a skilled movement. Some of the key characteristics in developing a coaching approach to assist athletes in skill learning were discussed, with particular attention paid to the use of learning styles and a more implicit approach to conveying information to athletes. These communication strategies, used in conjunction with the core principles of practice, provide coaches with guidelines for developing a successful practice environment.

References and further reading

Abernethy, B 1998, Training perceptual-motor skills for sport, in B Elliott and J Mester (eds), *Training in Sport: applying sport science*, John Wiley and Sons, London, pp. 1–68.

Berry, J and Abernethy, B 2003, Expert game-based decision-making in Australian football: how is it developed and how can it be trained?, research report submitted to the Australian Football League Research Board.

Farrow, D, Baker, J and MacMahon, C (eds) 2008, *Developing Sport Expertise: researchers and coaches put theory into practice*, Routledge, New York.

Magill, R 2006, *Motor Learning: concepts and applications*, 8th edn, McGraw Hill, Boston.