International Tennis Federation
www.itfcoachingreview.com
August 2013. 21th Year. Issue 60. 4-7
ISSN 2225-4757
https://doi.org/10.52383/itfcoaching.v21i60.448

Implicit motor learning: Designing practice for performance.

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ABSTRACT

The purpose of this paper is to review the concept of implicit motor learning in sport and to discuss the practical application of current techniques designed to induce implicit learning within tennis. Implicit learning refers to the acquisition of information without conscious awareness of what is being learnt. Research shows that skills acquired implicitly sometimes have advantages over skills learnt via explicit methods. Whilst some practice techniques that have been used in a laboratory setting to cause implicit learning may be impractical for coaches to adopt, there are several methods that coaches can (and should) consider using. These include the reduction of errors during practice, the provision of analogies as instructions, the concept of 'marginal perception' and the use of indirect instructional techniques.

Key words: Implicit learning, Skill acquisition, Talent development, Tennis.
Received: 3 June 2013.
Acepted: 2 July 2013.
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IMPLICIT MOTOR LEARNING: DESIGNING PRACTICE FOR PERFORMANCE

The concept of implicit motor learning, as first proposed by Masters (1992), is attractive and its proposed advantages have been discussed extensively in the literature. Despite this, it is not easy for coaches to apply practice methods to encourage an implicit mode of learning.

Learning is implicit when new information is acquired without explicit awareness of the details of the information itself. Sometimes the information is even acquired without intention, and the associated knowledge tends to be difficult to express (Reber, 1967). For example, a professional tennis player may be able to hit a hard, cross-court forehand, with an insuperable amount of topspin, yet they may have difficulty verbalizing how they hit such a difficult shot. As such, the skill has been learnt implicitly. Information learnt implicitly does not rely on (conscious) working memory, which culminates in more efficient performance (for a recent review of implicit motor learning, see Masters & Poolton, 2012). Substantial research has shown that skills learnt implicitly are resilient to the effects of psychological stress (Liao & Masters, 2001), physiological fatigue (Poolton, Masters, & Maxwell, 2007) and secondary task loading (Maxwell, Masters, Kerr, & Weedon, 2001), and has greater resistance to decay over time (Maxwell, Masters, & Eves, 2000). Thus, the benefits associated with implicit motor learning are desirable for all athletes, particularly in sports such as tennis where psychological stress and physiological fatigue are commonplace. The opposite of implicit learning is explicit learning, which is typically how we learn sport skills (e.g., receiving explicit instructions from a coach). This learning style is a highly conscious process and relies heavily on working memory. The downfall to explicit learning occurs when the athlete consciously re- engages information about the skill to control their movements. This can disrupt the 'automaticity' of the skill execution and, consequently, lead to a 'breakdown' in performance during highly stressful situations (Masters, Polman, & Hammond, 1993).

IMPLICIT PRACTICE APPROACHES

Dual Tasking

To allow skills to be learnt implicitly, practice needs to be designed so that the learner performs the skill without consciously thinking about the technique(s). Initial studies demonstrated that the 'dual- task practice' paradigm (Masters, 1992) resulted in skills being learnt implicitly.

This required participants to perform a secondary task (e.g., counting backwards in 3's from 150) while practicing the skill. While this type of practice was shown to create implicit learning benefits, the practicality of the method has been questioned. All studies that have utilized the 'dual-task practice' paradigm have reported considerably poorer performance compared to normal learning. It should be noted, however, that these studies have all used novice performers as participants and from the authors practical experience the method can be recommended with higher skilled players.

Errorless Practice

Errorless practice (Maxwell et al., 2001; Poolton, Masters, & Maxwell, 2005) involves guiding the performer during practice to ensure that errors are minimized. Such an approach also reduces the tendency to think consciously about performance, so explicit hypothesis testing is discouraged. For example, a child learning a tennis forehand may practice hitting a ball at a target on a wall. Gradually, the child would hit to smaller targets as the skills improve. Errorless learners have no need to test hypotheses since no errors are made, so learning is more likely to be implicit. Studies have shown that errorless learners are unaffected by the imposition of a secondary task, suggesting that such learning confers more efficient performance. This method of practice also may have possible psychological benefits as a consequence of increased confidence from consistently experiencing success (Masters, Poolton, Omuru, & ASARG, 2013).

Task Simplification

Another method to achieve a relatively errorless environment is to simplify the task. For example, it is common to see tennis coaches employ modified equipment with children learning the game to increase the probability of successful outcomes. When children play tennis with lighter racquets and lower bouncing balls, hitting accuracy and technique are better (Farrow & Reid, 2010; Larson & Joshua, 2013). Although achieving a 'true' errorless environment through equipment modification is improbable (given that some errors are still likely to occur), recent research has shown that modified equipment promotes less conscious processing than full size equipment in young children (Buszard, Farrow, Reid & Masters, in preparation). Specifically, the results showed that children had most difficulty coping with a secondary task (counting backwards from 150 in one's whilst hitting the ball) when using full size equipment, but not modified equipment. The authors therefore speculated that the use of modified equipment might promote implicit motor learning.

Analogies and Indirect Instructions

It has been demonstrated that the provision of instructions in the form of analogies evokes implicit learning (Liao & Masters, 2001). This involves providing a performer with one simple heuristic or a biomechanical metaphor that 'chunks' the task relevant declarative knowledge (i.e., rules) into an individually processed unit of information. For example, a tennis coach may instruct a player to "create a C shape with the racquet when hitting a forehand." Such an instruction captures the notion of swinging the racquet from low-to-high. Whilst providing a performer with an analogy is explicit in nature, it is cognitively efficient – meaning it demands few attention resources. The idea extends the argument that simple rules or heuristics are as effective as complex rules or algorithms for delivering technical instruction.

Although most of the implicit learning research has been geared towards motor skill performance, implicit instructional approaches have also been advocated for enhancing anticipatory skills.

Such an example is when the coach's instruction directs the player's visual attention towards key information, such as the anticipatory cue being provided by an opponent; but without directly telling the player what those cues are. Farrow & Abernethy (2002) showed that an 'implicit' training of this kind, which required players to adopt the perspective of a receiver and to predict the speed of each serve presented in a video training package, was more effective at improving return of serve anticipation than training that involved the provision of explicit instructions regarding the relationship between specific advanced cues in the opponents service action and the direction of the serve.

Marginal Perception

Another potentially useful training technique for a coach is the concept of 'marginal perception'. Marginal perception refers to a gradual change to stimuli without conscious recognition of the change (Masters, Maxwell, & Eves, 2009). For example, imagine this scenario: a tennis player is continually serving the ball into the net. The traditional approach to resolve such a failing would be to explicitly inform the player about the biomechanics of the serve. The player would most likely improve, but would also be consciously aware of the changes in technique. An alternative approach would be to begin practicing with the net at a lower height, thereby allowing the performer to serve the ball over the net with greater ease. Each training session the coach might increase the net height by the smallest of margins so that the player is not consciously aware of the change. Consequently, the player's movement patterns should subtly adapt to the change, even though they are not consciously aware of the adaptations that are taking place. Of course, eventually the player will become consciously aware of the net height changes, but by that stage, they have already learnt the skill unconsciously.

CONCLUSION

In summary, there is a range of benefits when skills are learnt implicitly and coaches should therefore be encouraged to consider how they could employ such practice techniques in their coaching. Importantly, coaches are urged to persist with implicit practice methods, even if short-term results from with explicit techniques are tempting. Implicit motor learning takes time, but the rewards are worth it!

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