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Applying the concept of chunking to tennis

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ABSTRACT

The goal of this article is to address how three accepted and researched motor learning stages, as well as the concept of mentally chunking information, relate to acquiring and accelerating the learning process in tennis. Stages of learning, the role of playing vs. practicing tennis, and the interaction between biomechanics and motor learning are discussed. Specific coaching tips are provided.

Key words: Chunking, stages of learning, motor skill performance
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INTRODUCTION

When we review the Grand Slam tournament results of the past decade, we see some exciting new players having excellent results. However, what stands out from the past is the exceptional longevity and continued success of several 'older' players. Players such as Serena and Venus Williams, Roger Federer, Rafael Nadal, Novak Djokovic and the Bryan brothers, each have been at, or near the top, for well over a decade. We know that all of them have exceptional talent, skills, and drive to achieve and maintain success. However, so have many other players who have not been able to win one or more major titles. So, what sets these players apart from other professional tennis players as well as athletes in other sports who often retire by age 30?

One reason for these top players' consistent success over time and physical ability might be related to their greater ability to mentally integrate and "chunk" the vast amounts of information in their performance. Chunking involves taking individual pieces of information and grouping them into a smaller number of meaningful (meaningful to the user and therefore, individual chunks will vary among individuals, dependent upon previous experience and current use of chunking processes) larger units (Schmidt & Lee, 1999). By integrating numerous tactical and stroke technique elements into larger blocks of information, the grouped information becomes easier to retain, recall, and execute in motor skills. Expert tennis players have figured out how to create and access these larger blocks of information in the most effective and efficient manner so that their on-court movement and strokes can look effortless and adapt to emergency situations (Roetert, et al, 2009b). Motor learning scholars note that effective chunking is an important characteristic of high-level motor skill performance (autonomous stage), such as driving a car, reading a book or preparing a dinner for guests. Fitts and Posner (1967) proposed that motor skill acquisition follows three stages: a cognitive stage, associative stage, and autonomous stage. Considerable research in kinesiology/exercise science and psychology has confirmed these stages and the importance of chunking in coping with the vast amounts of information in highlevel performance in dynamic sports like tennis and even medical practice (Cohen & Sekuler, 2010; Renshaw et al, 2010; Wulf et al, 2010; Taylor & Ivry, 2012, Wulf, 2013. Tenison & Anderson, 2016; Whitehead et al, 2016).

Unfortunately, even though this science of learning knowledge is readily available in the literature, the translation of that knowledge to teaching and coaching related to all stages of motor learning in tennis is lacking except for a few instances, such as tennis book chapters (Groppel et al., 1989; Woods & Fernandez, 2001). Therefore, it may be instructive to address how each of these motor learning stages and mental chunking relate to tennis skill acquisition with the goal of understanding, guiding, and accelerating learning and high-level performance in tennis. The first step is to analyze each of the stages in more detail. The second step is to understand the relationship between playing and practicing tennis and finally recognizing the interaction between technique modifications (biomechanics) and motor learning.

STAGES OF LEARNING TENNIS SKILLS

An important key to keep people coming back to the sport of tennis is to help them learn to play the game rapidly from the beginning. One of the critical roles of a tennis coach is to help players acquire the skills and strategy relatively fast and apply those skills in competitive play situations. Tennis coaches should not overemphasize elaborate cues and instruction and resist the tendency to share 'all they know' with beginners, even though this first stage of learning is called the cognitive state. Instead, coaches should focus on a few key instructional cues and design practice sessions that promote success in small steps.

Coaching Tip: Introduce skills in a way that promotes rapid learning, builds player confidence and increases motivation to continue to play.

When people learn the basic tennis skills rapidly, they find the time spent more enjoyable and have greater self-confidence, which often leads to better performance and additional play. Learning tennis skills quickly however is of limited value unless they are retained over time and they can be executed under the pressure of match play. With this premise in mind, the International Tennis Federation launched a worldwide campaign advocating the use of equipment scaling for children learning to play tennis. This included a modification of tennis courts, rackets and balls. Results from several research studies have indicated that these efforts have had a positive impact on learning tennis skills for children relative to traditional instruction with full-scale tennis equipment (Buszard et al., 2014a, 2014b, 2016; Farrow & Reid, 2010; Kachel et al, 2014).

Coaching Tip: Start children with properly sized equipment, reduced court size and lower compression tennis balls to encourage proper technique, earlier success, enhanced enjoyment and a greater chance of continued participation.

Many tennis coaches use some motor learning principles to accelerate the learning of tennis skills such as ground strokes, serves and volleys. For example, it is common for tennis instructional programs to introduce simple stroke movements first, before moving on to more complicated movements. Another approach is to introduce an entire skill, then break it down for practice into simpler parts of the stroke and then put all the parts together. When using this method of teaching a skill, Martens (2012) cautions us to consider how many parts there are to the specific task as well as how mentally demanding the task is. For example, it may be fairly easy to separate the toss from the swing in the serve however, we would not recommend separating the preparation and forward swing from the follow through, since there is much more interdependence.

Coaching Tip: When learning a new skill, consider introducing the complete tennis skill first to show what the result will/should look like (whole), if necessary, follow this by breaking down the skill into parts based on the need for change or complexity (part). Finally put it all back together in a competition format (whole).

The concept of chunking can be used in instruction to help players integrate the entire motor pattern of groundstrokes. For example, combining all the necessary groundstroke elements into three distinct sub-units such as: preparation, forward swing, and follow-through/recovery allows players to focus on fewer welllearned sub-units to be incorporated into a complex, effective groundstroke. The preparation phase includes anticipating the oncoming shot, judging the trajectory, speed and spin of the ball, and moving into an appropriate position to initiate a unit turn and stroke of the moving ball. The complete stroke involves using an appropriate grip, adjusting the backswing and executing a forward swing to contact the ball. Finally, the player finishes the stroke with a follow-through and begins court recovery for the return shot. The player must be attentive to their body balance throughout the process, keep muscle tension at an appropriate level and their head still throughout the stroke.

Perfecting a motor program just to hit one groundstroke may seem like a daunting task, but by grouping these numerous technique factors into three main chunks, it is much easier for players to remember them during the cognitive or first stage of learning. From the player's point of view, her job is simply to focus on preparation, swing/stroke, and recovery.

Once the initial stage of motor learning is achieved, players move into the associative or motor stage where they practice the learned movements repetitively, smooth out the execution, and aim for repeatability of the desired motor pattern. At this stage, the repetition also insures retention of the learning which of course is crucial to establish before moving on to the next stage which is the autonomous stage typically reached by elite athletes only after many hours of practice.

During the associative and autonomous stages of learning, information that is "chunked" is more easily retained, repeated and eventually performed without conscious thought. This is very much in line with the concept of implicit learning whereby the player acquires new information without explicit awareness of the details of the information itself (Buszard, et al, 2013). Fitts and Posner's model, explains this as an emphasis shift in control in which initial, explicit control gives way to more routinized forms of control. In fact, when elite performers are asked in post-match interviews how they performed a specific shot in what appeared to be a turning point in a match, they often respond, "I don't know, I just hit it like I do in practice, which is consistent with the research on the nature of expertise (Chi, Glasser & Farr, 1988).

Coaching Tip: In practice sessions with advanced players, focus on strengths as well as weaknesses. Reinforcing strengths helps a player's confidence and provides support for the automaticity of the stroke.

PLAYING VS PRACTICING TENNIS

Playing tennis games and matches is quite different from simply learning movement and stroke skills. Most players learn groundstrokes first and learn to rally the ball back and forth with a partner to gain consistency and limit errors of execution. When they decide to play a complete point however, the serve and return of serve begin every point thus requiring two additional skills followed by the strokes' tactical skills in each rally. If a point lasts long enough, other skills such as approach shots, volleys, overhead smash or lobs may become necessary. Once again, players are faced with a new learning challenge of playing a point rather than simply performing isolated skills. A variety of skills must be linked together quickly and automatically at elite levels during every point. Making it more complicated is that every point has its own pattern and sequence of shots based on the opponent and the environment. Once again, the concept of "chunking" large amounts of data into smaller more manageable parts can be very helpful to coaches and players.

Players often learn tennis skills by performing the same skill repetitively in what are called "blocked trials." Often the coach feeds balls and the players are expected to perform the same shot repeatedly until a certain level of success is reached. Both the coach and the player feel pleased with his performance and believe the shot has been well learned through greater repetition in a short amount of time. However, when the player tries to play a match, the stroke often is ineffective because in fact it was practiced/learned in stable conditions, not in the more dynamic and unpredictable situations encountered in match play.

To properly learn to play points, players must use "random trials" (instead of blocked) where the next shot is unpredictable, and players may be required to make a series of rapid adjustments and choices before returning the ball. An additional complication is that it is much more difficult to return an unpredictable shot from an opponent than more consistent machine projected or hand-fed ball from a coach. Tennis players should spend most of their practice time once they reach the associative/motor and autonomous stages performing "live ball" drills or playing points rather than "dead ball" (coach fed) drills.

Coaching Tip: During the associative and autonomous stages of learning, the majority of practice time should be focused on live ball drills to mimic match play situations.

Chunking the information during live ball drills allows higher level tennis players to make quick decisions as to which shot they should choose and how much speed, spin and depth they should aim for. They can also estimate the margin for error they are willing to accept depending on the score and the point in the match.

Playing the game also introduces the concepts of overall strategy and specific tactics executing that strategy in a match. Although these terms are often used interchangeably, there is a difference between the two. Strategy is an overall game plan based the laws of physics and the relative strengths/skills of the player and their opponent. Generally, hitting ground strokes crosscourt is typically the best choice because the net is lower in the middle and the length of the court is longer to the baseline on the diagonal line (85 feet) vs. down the line (78 feet). These factors normally help reduce the incidence of errors. Tactics, on the other hand is an adjustment of a strategy based on numerous situational factors. For example, your opponent's strengths and weaknesses, court conditions, the score of the match, and weather conditions can all influence if the predominant target in lateral strokes should be crosscourt.

To make strategic and tactical decisions during a match or within a point, a player's recall of possible options must be rapid and accurate. Again, the chunking of information during the learning process will support the execution phase by helping players remember all the available strategic options and then consider any tactical adjustments within a few seconds. For example, a player who approaches the net may find the opponent lobs the next shot. The response typically would be to play the ball out of the air with an overhead smash to end the point. But if the lob is very high, into the sun or it is a windy day, it would be a good tactical decision to let the ball land and smash it after the bounce to reduce the difficulty of the shot. Learning to make split-second decision such as this example can be enhanced and retained by chunking the possible tactical choices so that an automatic decision can be made.

Coaching Tip: During practice matches, point out errors of shot execution versus errors of strategy or tactics. Help players differentiate between the types of errors and choose the best shot at the right time.

INTERACTION OF BIOMECHANICS AND MOTOR LEARNING

At each of the stages of motor skill acquisition, coaches observe and evaluate stroke technique, and after diagnosis, can intervene in the practice to help players improve their strokes. This important professional skill is called qualitative movement diagnosis (Knudson, 2013) and should go beyond just the traditional error detection and feedback. This prescription of practice, conditioning, or technique should be made with considerable carea. While the general consensus of

biomechanical research on skilled performance of tennis skills is known (see Knudson, 2006), what is optimal, or best at specific stages of development, has not yet been explored by research. For example, recent research findings have shown that common practice tasks are often not representative of the shot and movement characteristics typical of match play. Therefore, more careful design of practice sessions should be considered (Krause et al., 2018). In general, the level of player should be considered so coaches can carefully instruct or modify practice, continually observe, evaluate, and diagnose the player's performance. Expert tennis players are more efficient at handling large amounts of information (larger chunks because they are meaningful) in match play, than less skilled/experienced players, so communication and intervention are different than with beginning or intermediate level players.

Coaching Tip: With advanced players, collaboratively decide on the best time to intervene and make technique changes and when to allow for player self-diagnosis/adjustment. Technique adjustments in well-learned skills will be difficult to relearn and can, initially, decrease performance. Determine when tactical, conditioning, or psychological intervention might be most appropriate.

Differences with lower ranked players may be that the very top players chunk information, encode more efficiently and retrieve information faster (Knudson, 2013). For example, the tennis serve requires a timed sequence of individual body part forces to optimize racket velocity at contact. A well-coordinated timing of the body segments, in a largely proximal to distal (legs, trunk, and arm/racket) fashion, as well as sequencing of these forces needs to be carefully timed within thousands of a second for optimal success (Roetert, et al. 2009a). Timing the biomechanical variables of the groundstrokes may be even more difficult as they are mostly not hit from a stationary position and various stances may be used (Roetert et al, 2009b). In fact, advanced players more efficiently anticipate, react, and move in response to game situations. Vernon et al. (2018) attribute this to anticipatory information, in the form of kinematic and contextual information sources, becoming available to a performer at various times prior to an opponent making contact with the ball in time-stressed game situations.

Keep in mind that in addition to skill differences within certain groups, junior players for instance, there are also differences between groups such as junior players and professional players. Often these differences between the competitive performance characteristics of junior and professional tennis players are not well understood. Research by Kovalchik and Reid (2017) indicates that understanding how competitiveness, play demands, and the physical characteristics of shots differ between junior and professional tennis players can help set realistic expectations and developmentally appropriate training for players transitioning from one level to the next. In this specific example, although both groups have reached the autonomous stage of learning, corrections and refinements should be made based on experience, maturity and need.

SUMMARY COMMENTS

From a coaching perspective, it is clear professional tennis players have reached the autonomous stage of skilled performance. Elite level tennis requires outstanding agility and skill, but the best professionals often chunk the myriad of tactical, movement, and stroke decisions demonstrating efficient performance and making the seemingly impossible shot. Since the sub-units of the swing are organized in chunks of information which are largely automatic at this stage, movement execution requires little or no direct cognitive attention. As Wulfe (2007) has pointed out, more attention can be directed at other (tactical, motivational, etc.) parts of the performance. Developing tennis players in the associative stage may not have reached the complete fluency of a skill yet may have mastered a level of fluency and consistency with their strokes. This allows for subtle adjustments as the "chunks" of information are being developed. During the cognitive stage, players still pay attention to a step by step execution of the strokes while trying to figure out the best way to improve their performance. This clearly requires more cognitive attention with few, if any, of the movements being automatic.

Coaches should focus on these different stages of learning and pay close attention to improvements in this learning process. As a skill, stroke, or components of a swing become more automatic, chunks are being assembled into larger logical units. This allows for these skills to increase in accuracy, efficiency and overall performance with less need for attention. In other words, greater flow of performance. Keep in mind that, even though motor skills vary widely in type and complexity, the learning process that individuals go through when acquiring various motor skills is similar (Wulfe, 2007). Skilled tennis coaches will be effective guides on the court, knowing when and how to intervene in practice.

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