

WHAT TENNIS RESEARCH TELLS US ABOUT... ANTICIPATION AND VISUAL SEARCH

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Below are summarised a series of articles on tennis anticipation and visual search which have appeared in sport scientific publications. Coaches interested in obtaining more information from these articles can find them using the relevant references.

Anticipation in junior tennis players

In this study the author reported that expert players are able to “read” such things as: angle of the racquet face, travelling arc of racket head, line of shoulders, weight transfer, and ball toss location. The author concludes that the studies systematically showed faster information processing and decision times for experts; experts are also more proficient (greater accuracy, greater number of correct responses) than novices. Expertise leads to regularised structure and sequence of processing variables. Moreover, choice confirmation seems absent in experts, whereas beginners come back on already processed cues.

*Day, J.L. (1980). Anticipation in junior tennis players. In J.L.Groppel & R. Sears (Eds.), **Proceeding of the International Symposium on the Effective Teaching of Racquet Sports** (pp.107-116). Champaign, Ill. University of Illinois.*



Anticipatory timing of beginners and intermediate tennis players

The results of this study on anticipatory timing showed that beginners and intermediate tennis players experienced very little success in predicting latitude, longitude, or exact ball placement in two restricted viewing conditions: 10 ms (prior), and 0 ms (contact). According to these authors, such findings suggest that players were, at these levels, unable to identify relevant cues emitted by the server. Similar results were also found by Jones and Miles (1978).

*Use of advanced cues in predicting the flight of a lawn tennis ball. **Journal of Movement Studies**, 4, 231-235.*

*Isaacs, L.D. & Finch, A.E. (1983). Anticipatory timing of beginning and intermediate tennis players. **Perceptual and motor skills**, 57, 451-454.*

Analysis of the visual indexes in the return of serve

An analysis was made of the different visual patterns of expert and novice tennis players preparing to return a tennis serve. Sixteen-mm films were used for testing purposes; flat, top-spin, and sliced serves delivered by a right-handed and a left-handed server were presented to subjects. For scanpath analysis, the serve was divided into three phases: ritual, preparatory and execution phase. When computing the number of exchanges occurring between two locations during each of these phases, it was found that: (a) experts look around the head and the shoulder/trunk complex (general body position) of the server more frequently than do novices, (b) there seems to be little difference during the preparatory phase since both experts and novice centre their ocular fixations around the ball or its expected position, and (c) during the execution of the serve, fixation sequences of experts are linked to cues originating from the racquet and the arm holding the racquet, whereas novices organise their sequences by using a greater number of cues. During this phase, experts terminate their visual search on the racquet at the moment of impact, whereas beginners frequently prolong their processing by following the ball trajectory after impact. Privileged cues (upper limb, anticipated ball placement) emphasise the fact that experts make use of cues relying on the interpretative function of their visual system.

*Goulet, Fleury, Bard, Yerlès, Michaud, & Lemire (1988). Analyses des indices visuels prélevés en réception de service au tennis. **Canadian Journal of Sport Sciences**, 13, 79-87.*

Skill level, peripheral vision and tennis volleying performance

The present study was an attempt to investigate the relationships between skill level, peripheral vision and tennis volleying performance. Subjects were tennis players of three different ability levels. A tennis volleying task performed by all subjects under conditions of full and occluded visual feedback, yielded measures of accuracy and control at two different ball speeds. Results indicated that, contrary to recent studies of one-handed catching, vision is not a pre-requisite for successful arm and positioning during volleyball. This suggests that with regular training a player may develop a more acute sensibility to the perceptive signals he receives when

positioning the racquet for the volley thus relying less on watching the actual flight of the ball (visual feedback).

W. Davids, D.R. De Palmer, & G. J. P. Savelsbergh (1989). *Skill level, peripheral vision and tennis volleying performance. Journal of Human Movement Studies.*

Information processing and attention with expert tennis players according to their age and level of expertise

The present experiment was an attempt to study the information processing and attention with tennis players. They had to respond by pressing a single key to the onset of different lights that were cue signals. Results showed that: (a) expert players were faster than non experts, (b) oldest players were faster than the others, (c) the more expert and the older the players, the shorter the reaction time, and (d) the players were faster to detect the near lights than the far ones. These results suggest that: (a) the development of concentration is relative to growing up and learning, and (b) younger players show a lack of concentration when compared to adults since their concentration is more narrowly focused and less flexible.

Nougier, Azemar, Stein, Ripoll. (1989). *Information processing and attention with expert tennis players according to their age and level of expertise. Proceedings of the 7th World Congress on Sport Psychology, 237.*

Expertise differences in preparing to return a tennis serve: a visual information processing approach

The technique of temporal visual occlusion was used to estimate the ability of expert and novice tennis players to use advanced visual cues to recognise the type of serve delivered. A 16-mm film of servers delivering different kind of serves was used. The filmed sequences were divided into five randomly presented segments with parts of the serve occluded. Only serves delivered by a right-handed server were used. Five situations were created from more to less occlusion of different serve parts. There were group differences in all situations. These results suggest that valuable information is selected by expert players during the preparatory phase and during the first part of the execution phase, i.e., from the placement of the ball and the initiation of upper body rotation and the arm/racquet complex motion. Experts players focus on the shoulder/trunk areas, the remaining information seems to be redundant, whereas novices concentrate their focus around the head of the server. During the execution phase, experts concentrate on the racket whereas novices use more cues. Experts take better advantage of pre-flight cues and need less information to identify the type of serve presented. Accuracy and speed of response are enhanced in experts via their ability to extract information earlier. Novice players used the information differently. Unlike experts, they had to see the ritual phase until ball/racquet impact to be accurate. For them, the ritual period could be a specific preparatory period favouring capture of subsequent cues and evaluation of the upcoming serve. When deprived of the ritual phase, novices were less "tuned" to code the valuable information present in the first phases of the serve

liable to allow identification of the type of serve delivered. They also needed complete vision of the movement patterns of the server (until ball impact) to be accurate.

Goulet, C., Bard, C. & Fleury, M. (1989). *Expertise differences in preparing to return a tennis serve: A visual information processing approach. Journal of Sport and Exercise Psychology, 11, 382-398*

The demands on concentration in the preparation to return a serve

A dual-task method was used to evaluate the relative demands of concentration in the processes leading to anticipation of the type of serve delivered in tennis. The primary task consisted of identifying - as in previous experiments - the type of serve presented through a 16-mm film. The secondary task required a manual response to an auditory probe. As expected, the primary task performance of the expert group was superior to that of the novice group. From these results it is noticed that the demands of concentration are similar in both experts and novices, but performance (accuracy of the response and the decision time) differs, favouring the experts. Beginners depend more upon actual stimuli, they are "stimuli given", whereas experts, in order to anticipate their response, rely heavily on memorised schema; they are "memory driven". Differences between skilled and unskilled players do not lie so much in the speed of operation of the perceptual system but on the organization of the motor system that uses the output of the perceptual system. Results demonstrated that the demand in concentration to assimilate information processed during the ritual phase of the serve are higher than the demands of processing information from the preparation and execution of the serve. It appears, therefore, that effort of concentration is at its peak before identification of the most important cues necessary for adequate performance.

Goulet, Bard, & Fleury (1992). *Les exigences attentionnelles de la préparation au retour de service au tennis. Canadian Journal of Sport Sciences, 17, 98-103.*

Mental Speed Training in Beginner/Intermediate Tennis Players.

The trainability of anticipatory skills for tennis was assessed. Subjects (N = 34) from a beginner/intermediate tennis class were randomly assigned to either a mental speed or a physical speed (control) training group. They were tested in three laboratory-simulated tennis tasks and three on-court tasks (serves, groundstrokes, and volleys), 1 week before and after the 3-week speed training program. The analyses that were conducted revealed for the laboratory tasks, that the mental speed group made faster decisions in reaction to serves, exhibited faster anticipation times, and showed improved accuracy in predicting serve type and location. No improvements in accuracy were found in the physical speed group. For filmed match-play situations, the mental speed group improved reaction times with training and committed fewer response errors. In general, research indicates that expert tennis players focus

on more meaningful and predictive cues that enhance quick and accurate decision making. In addition, highly skilled performers are better at resolving uncertainty concerning an opponent's actions from earlier cues than beginners. Laboratory results indicate that anticipatory skills can be enhanced in lesser skilled players when appropriate methods are used. The findings suggest that teaching the ability to select and extract meaning from certain anticipatory cues of an opponent's serving motion can greatly enhance the decision-making capabilities of the returner. Coaches should not overlook the need to guide young players in determining appropriate anticipatory cues in various tennis situations.

Singer, R.S., Cauraugh, J.H., Chen, D., Steinberg, G.M., Frehlich, S.G. & Wang, L. (1994). Training Mental



Quickness in Beginning/Intermediate Tennis Players. The Sport Psychologist, 8, 305-318

Visual Scanning and Selective Attention: Elite Versus Novice Tennis Players

This study monitored eye positions while elite and novice players watched filmed tennis opponents perform. Subjects made decisions about two tennis strokes: (a) service type (flat or spin) and directions (left, right, or center) and (b) ground strokes directions. Analyses of the decision making times indicated that elite players made faster decisions, more accurately than the beginners for both types of strokes. Analyses of the eye positioning data revealed significant Fixation Area x Skill level interactions for number of fixations for both strokes.

J. H. Cauraugh, R. N. Singer, & D. Chen, (1996). Visual

Scanning and Selective Attention: Elite Versus Novice Tennis Players NASPSA Abstracts, S14.

Visual search, anticipation, and reactive comparisons between highly-skilled and beginner tennis players

Simulated tennis playing situations were created for the laboratory testing of visual search patterns, anticipation, reactions and movements to compare male and female, high-level and beginner players. Participants were highly rated university players (N=30) and students enrolled in a beginners tennis class (N=30). Visual search patterns were recorded as they viewed filmed opponents serve and groundstrokes. Also recorded was anticipation accuracy and speed of the intended type and location of serves and the intended placement of groundstrokes. In other testing, execution of split-step was followed by moving rapidly to the correct location for a simulated stroke in response to a series of light cues. Reaction and movement times were recorded. Analysis revealed that: (a) beginners directed more time towards the head region than did the highly skilled, (b) experts were faster and more accurate than beginners for anticipation of the serve and for groundstrokes, (c) as for the reaction and movement times in the split-step, experts were faster than novices and males were quicker than females.

Singer, R.S., Cauraugh, J.H., Chen, D., Steinberg, G.M., Frehlich, S.G. (1996). Visual search, anticipation, and reactive comparisons between highly-skilled and beginning tennis players. Journal of Applied Sport Psychology, 20, (1), 9-26.

Other articles on this topic

Castiello, Umiltà (1988), Attenzione e tennis. Rivista di Cultura Sportiva.13, 28-33.

Fukami, Fujita, Yoshimoto, Kawahara, Mizuochi, Sukui, Kondoh, Satoh. (1989). A study of temporal adaptation in motor learning: Modelling return of service in tennis. Proceedings of the 7th World Congress on Sport Psychology, 104-105.

Vom Hofe, A. & Fery, Y.A. (1991). Attentional demands of a temporal prediction task: The trajectory of a tennis ball. Perceptual and Motor Skills, 73, 1235-1243.

Goulet, C., Bard, C, Fleury, M. (in revision). Peripheal visual information processing in preparing to return a tennis serve. Human Movement Science.