



UNITED STATES TENNIS ASSOCIATION

The Use of Visual Information for Anticipation in Highly Skilled Tennis Players

Carlton, L.G. & Chow, J.W.
Department of Kinesiology
University of Illinois at Urbana-Champaign



University of Illinois at
Urbana-Champaign

This research was funded by a USTA Sports Science and Medicine Research Grant (1998/1999).

INTRODUCTION

- Quick movements requiring fast and accurate reactions to one's opponent are important in almost all shots in tennis, especially the return of serve and volley.
- In these strokes, the time to react varies depending on factors such as the speed of the ball and the closeness of the opponent.
- The ability to "read" an opponent's shots increases a player's readiness to respond, reduces the time of a player's response, and results in improved performance.
- While it is assumed that skilled players are good at "anticipating" the movements of their opponents, there is little research based evidence that athletes' speed of reaction is faster when *visual information* gathered before ball contact (e.g., an opponent's stance, movements, or position on the court, a ball's trajectory, etc.) available.
- Also, little is known of the types of visual information that is needed and that skilled players tend to use to make appropriate and successful responses during play.
- This research project was conducted in two parts to address these two issues.

PURPOSES

- To determine whether skilled tennis players were able to use pre-ball contact visual information from their opponents' movements to react more quickly and accurately than when they volleyed balls projected by a ball machine or when the players were placed in a laboratory experiment that tested a non-tennis related reaction time task.
- To determine the types of visual information the players used to anticipate the stroke type used by the opponent and the direction of the resulting ball flight.



SAMPLE

- Experiment 1:**
- 9 players from a top ranked collegiate tennis team
 - National Tennis Rankings: 6.0 (n = 1) and 7.0 (n = 8).
- Experiment 2:**
- 12 male tennis players
 - National Tennis Ratings: 5.5 or above



OVERALL PROJECT METHOD

- **Experiment 1:** Players were asked to volley balls hit by a live "opponent" or delivered by a tennis ball projection machine. Reaction times were measured as the time between when the ball was hit by the "opponent" or projected from the ball machine and when the players first moved their racquets in response to the hit/projected balls. The players also participated in a reaction time laboratory experiment in which they were asked to push a button with their right or left hand in response to the flashing of one of two (left or right) lights on a table in front of them.
- **Experiment 2:** video recordings of skilled tennis players hitting a down-the-line passing shot, a down-the-line lob, a cross-court-passing shot, and a cross-court lob from the baseline were shown to a group of 12 male tennis players (with National Tennis Ratings of 5.5 or above). The recordings of each shot were edited so that portions of the recorded players were not visible to a viewer. More specifically, for each of the shots described above, clips were created under the following five conditions: 1) no visible racquet, 2) no visible racquet and lower arm, 3) no visible upper and lower arm, 4) no visible upper arm and trunk, and 5) no visible lower body. The participants watched a life-size image of the players projected onto a screen across court and were asked to move in the direction they believed the ball was hit by the projected player. Players' reaction times in each trial were also measured in this portion of the study.

RESULTS

- Players were able to react more quickly when they could see the movement pattern of their "opponents" as opposed to conditions in which they were fed balls by a machine.
 - Reaction times were reduced by about 25% when they could see the actions of their opponents.
- Players' reactions in the tennis environment were much faster than reactions in the laboratory experiment.
 - Even when balls were projected by the ball machine, reaction times were significantly faster than the lab reaction time task.
 - These results may have been due to the large amount of specific practice players have with on-court tennis tasks. Pushing buttons in response to a stimulus light most likely was not a task these players had regularly practiced before the experiment.
- Players were able to consistently (greater than 50% of the time) anticipate *stroke type* (i.e., passing shot versus lob) and *stroke direction* (down-the-line versus cross-court) from their opponents' movement pattern before ball contact.
- *Ball direction* was more difficult to anticipate than *stroke type*.
- It appeared that visual information about the racquet and lower arm was used to determine the *type of stroke* that was used by a player.
 - This conclusion was reached because elimination of this information (i.e., when participants could not see the racquet and/or the lower arm of the video recorded player) caused anticipation accuracy to drop, while elimination of other aspects of the players' movements (e.g., upper arm or trunk) had no influence on anticipation accuracy.
- Missing visual information of the various body segments and the racquet had no influence on the anticipation accuracy of *ball direction*.



YEAR PERFORMED 1998

RECOMMENDATIONS

Visual information of an opponent's movements is important for your players to be able to more quickly and accurately respond in many competitive situations.

- Practicing with live opponents versus a ball feeding machine will help your players learn to look for and respond effectively to these visual cues.
- You can help your players by drawing their attention to the use of visual information by explaining the types of cues they should be looking for and what this information may indicate in terms of their opponents' shots (e.g., the depth of a given shot).

For your players' to gain the most advantage from observing opponent-movements, direct their attention to their opponents' lower arm and racquet movements.

- This information appears to be useful for anticipating the depth at which a particular shot will be hit.
- While this study did not find visual information from an opponent's upper arm lower body, or trunk to be as useful for predicting and anticipating resulting shots, information from these body segments may be useful for certain individuals. Do not discourage your players from attending to these areas if they provide useful information to the athletes.



CONCLUSION

This study demonstrated that skilled players use visual information from their opponents' swing to help them react quickly for shots like the volley. The results also showed that the racquet and lower arm provide the critical information about the stroke that was hit. However, more information is still needed about issues such as player reaction times in competitive situations and the effectiveness of training regimes used to teach players to use pre-contact visual information.