Table Tennis Technical Review

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How players detect the spin of the ball during the return of serve in table tennis

Abstract

It is well documented that the accurate motor responses of table tennis players are based on a visual system that functions as an efficient cycle to select, capture and process information. Each time they return the ball, players use this information loop that repeats itself many times in the course of a match. As the acquisition or perceptual phase has often been considered to be of primary importance, eye movement studies have highlighted the role of visual tracking during the first part of the ball's trajectory. However, there is a need consider incoming information from the periphery of vision that can be decisive in whether a serve is successfully returned.

Therefore in two experiments, we used temporal and spatial occlusions in which the task was for players to predict the directions of the spin of the ball. Four kind of backhand serves where used: down-spin, no-spin, top-spin and side-spin.

The results of the first experiment showed an increase in performance before the impact of the ball. In the second experiment, a decrease in performance was observed when the paddle and the body of the player were occluded. These results show that, for both novices and experts, the most important cues in detecting the spin of the ball are those shown from the paddle just before impact time.

Key words: *table tennis, psychology, visual perception, visual search*

Introduction

This work analyzes the relationship between visual perception, sports performance and anticipation skills. Improved technique in table tennis has decreased the number of hits per rally. For this reason, serves and returns are of primary importance (3). According to same studies, ball speed can reach 160 Km/h (6) and spins can reach 8000 rpm (10). On the serve return, not only motor response is very important, but visual selection of significant information at the right time as well. There are few studies on table tennis. More studies

have been conducted in other sports like cricket and tennis. A previous study on visual search in table tennis takes advantage of eye movement's methodology (7, 8, 9). According to some authors (11, 12), this methodology presents a disadvantage because it does not consider incoming information from the visual periphery. For these reasons, we decided to use temporal occlusion and spatial occlusion methodologies in two experiments where subjects had to predict the spin direction of the ball. Also, occlusion methodology was never used in table tennis.

Experiment 1: temporal occlusion

Method

Subjects

These were 30 right-handers divided into two groups: 15 expert players (5 females, *M* =29.7, *SD*=21.2) and 15 novices inexperienced in racket sports (5 females, *M* =28.8, *SD*=7.3).

Stimuli

Using a video PAL camera (Panasonic NV-GS17), we recorded a table tennis player executing four different types of serves: topspin, flat, back spin, and side spin. The four videos were interrupted (occluded) in five different instants: start (-T2), ball at the top of trajectory (-T1), ball in contact with the paddle (T0), ball in flight (T1), and ball in contact with the table of the server (T2). All videos ended with a black frame.

Procedure

The test was run on a computer laptop (Dell Inspiron 1501, Athlon Dual 1800Mhz, Video Card ATI 1150). Participants were seated approximately 60 cm away from the screen (15''4 resolution 1280x800) they had to press the F5 button with a finger on their left hand to start each trial and answer with the right-hand finger using a four-button key paddle, . The experiment took the form of a 5 occlusions x 4 services x 6 repetitions design. The subjects were required to watch 120 video clip segments and predict the different kind of serve.

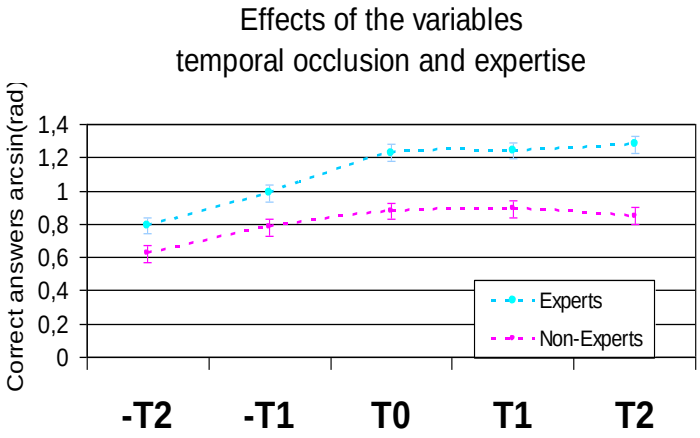
Data analysis

We measured the percentages of correct answers for the variables of expertise, occlusion, and type of serve. The data with an arcsin transformation was analyzed in a two way ANOVA with expertise as a between-subjects factor and occlusion as a within-subjects factor.

Results

There was a significant main effect for expertise with the expert group showing a superior performance compared to the novice group in all of condition ($F_{(1,28)}$= 25,35, p.<0,0001). For both groups the trend was similar, before T0 there was

an increase in performance and after T0 the performance peaked ($F_{(4,112)}$=46,56, p.<0,0001). See figure below.



Experiment 2: spatial occlusion

Method

Subjects

These were 42 right-handers divided into two groups: 21 expert players (4 females, *M* =30.4, *SD*=15.8) and 21 novices inexperienced in racket sports (4 females, *M* =28.7, *SD*=7.3).

Stimuli

We used the same basic four videos from Experiment 1. These were modified using a video effects program (After Effects 7) to produce four different conditions. Condition C0, the control condition, was the same of condition T2 of Experiment 1. In condition C1, the body of the player was covered by a black mask; in C2, the ball was deleted from the clips; and in C3, the paddle of the player was also deleted (variable occlusion).

Procedure

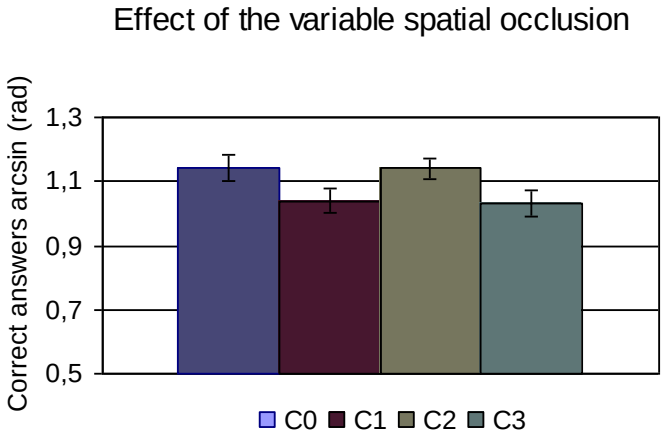
The test was run on the same apparatus of the previous experiment and the task was also the same. The experiment took the form of a 4 type of serve x 4 occlusions x 6 repetitions design. The subjects were required to watch 96 video clips and predict the different kind of serve.

Data analysis

We measured the percentages of correct answers for the variables expertise and occlusions. Before the execution of the statistical analysis, we applied an arcsin transformation to the data. For the statistical analysis, we used a two way ANOVA for the variables expertise and occlusion.

Results

The expert group showed a superior performance compared to the non-expert group in all conditions, $F(1,40) = 41.78$ $p<0.0001$. For both groups the condition C1 (absence of body) and condition C3 (absence of paddle) caused a consistent decrease in performance $F(3,120)=14.27$ $p<0.0001$. See figure below.



Discussion

Many researchers have considered the acquisition or perceptual phase of primary importance in table tennis and, in eye movement studies; they have examined visual tracking of the first part of the ball trajectory (5, 7, 8, 9). However, this methodology, does not consider incoming information from the periphery of vision (12).

The serve at the start of the game is a very powerful stroke in modern table tennis. This kind of stroke can differ for speed, landing sectors and for different spins used with forehand or backhand. In 2001, to reduce its power, the International Table Tennis Federation introduced new rules intended to increase the number of hits per rally for the purpose of enhancing spectator interest in the game. In particular turning became obligatory each two points instead of five and masking that consists in covering the descending trajectory of the ball with the free arm is no longer allowed.

In no other sport does the ball rotate so quickly as in table tennis. Brad, Fleury, and Goulet (1989) studied subjects' ability was to identify the type of serve delivered (flat, top-spin, sliced) as fast and accurately as possible for each serve presented, though on tennis rather than table tennis. We adapted this methodology in a table tennis situation but with of the use occlusions.

Bearing in mind that only a backhand serve was tested in our studies, our findings in Experiment 1 suggest that the spin of the serve is important to pick-up information before the impact of the paddle with the ball. In Experiment 2,

the results point to the importance of the cues that come from the paddle and the body of the player. Considering of these experiments together, there is support for the hypothesis that the crucial information for detect the spin of the ball comes from the paddle before the impact with the ball. The decreasing performance for body occlusion could be explained considering the body as a reference point for the periphery of the visual system to select cues necessary for returning the serve.

Conclusion

These studies have some practical implications. In particular, anticipation is a very important mechanism and must be continually improved during training sessions to forcing player to act as soon as possible for perceive the early significant cues. However, to avoid errors in competition, a player may choose the strategy to wait slight longer to process information or cues from the body, paddle or ball of the opponent. In the future, it would be interesting compare different kind of service, for example backhand vs. forehand or a simple serve vs. a serve with a feint.

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