

Anticipation . . . an important element in doubles play.

Improving Anticipation in Racquet Sports

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It is generally agreed in most coaching texts on sports such as squash, tennis and badminton that the ability to anticipate the flight path of the ball (or shuttle) before it is actually struck by the opponent is one of the most critical factors for successful performance. In this article we examine why anticipation is important, and indeed essential, in racquet sports, what sources of information are available to aid in anticipation of these sports and some practical

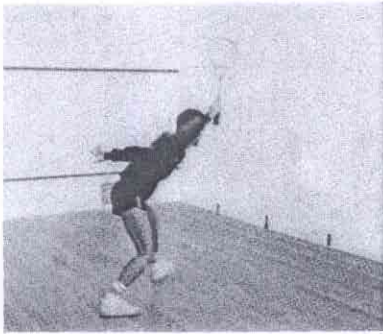
approaches toward improving the anticipation of expert and novice players. In doing so we describe some recent research on the relative advance cue usage of expert and novice squash and badminton players.

Why is anticipation necessary in racquet sports?

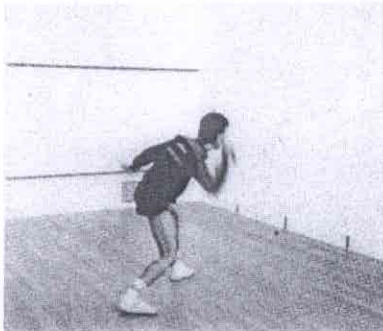
In a racquet sport such as tennis the time between when the opposing player

strikes the ball and the ball reaches the receiver may be as short as half a second (or 500 milliseconds). If the receiving player waits until he/she sees the ball in flight before deciding what direction they need to move in in order to play a return stroke they will usually have insufficient time in which to execute their return stroke effectively. This is simply because the total time taken to react to the direction of the ball, to move the whole body from its current court position to the position needed to execute the return stroke and to then complete the chosen stroke itself is much greater than the time taken for the ball to travel from one end of the court to the other. It takes, for example, at least 300 milliseconds to just decide which of the two options has occurred (eg is the ball going cross-court or down the line) and another 300 milliseconds to simply complete the downswing movement of the racquet so clearly the skilled players

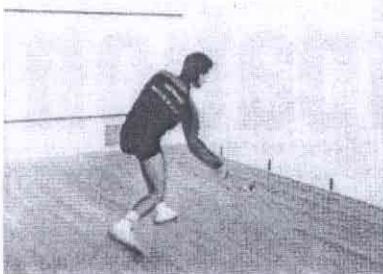
Figure 1



t1



t2



t3



t4



t5

must rely on earlier information than that provided by ball flight to determine the direction and force of the opposing player's stroke. Given that under the stressful, high-speed conditions of competition expert players can still present the impression of having "all the time in the world" (Bartlett, 1947), despite these time constraints, it becomes self-apparent that anticipation must be an integral part of successful performance. [It is worth noting that the arguments developed here for the importance of anticipation to skilled performance hold equally well for most fast ball sports. More detailed examples of the temporal constraints upon information-processing in fast ball sports may be found in Glencross & Cibich, 1977 or Abernethy & Russell, 1983.]

What sources of information are available to aid anticipation?

In trying to predict in advance the direction and force of an opponent's stroke two sources of potentially useful information are available to the racquet sport player. Firstly there is information available before the stroke even commences related to the **probability** of the opponent hitting a particular type of stroke. Not all possible stroke options are used with equal probability by most players — rather they use some particular strokes (and combinations of strokes) more often than others. The probability of an opposing player hitting a given type of stroke is often contingent upon such factors as their court position (eg drop shots in squash are less probable from the back court than from the front court), the preceding events in the rally (eg the movement of a player to the net to volley in tennis is more probable if the preceding stroke has been a deep one), the game strategy (eg down-the-wall strokes are "lower risk" options in squash than are cross-court strokes) and their individual strengths and weaknesses of the opponent (eg some players will hit more cross-court than down-the-line strokes simply because of their stroke mechanics). Any prior knowledge that a player has regarding one stroke option being more probable than another can be used to improve their anticipation and reduce their reaction time.

The second source of information available to aid anticipation comes from postural cues give off by the opposing player during their stroke preparation. If one considers that each stroke is made up of a sequence of discrete events (as illustrated in Figure 1) and that each event is somewhat dependent on the preceding one then it may be possible to predict the final event (the direction and speed of the

struck ball) from earlier events, such as the movement of the player's racquet, arm or lower body. Indeed as Annett & Kay (1956) proposed some years ago:

"In an invariant sequence of events the skilled man views all his information at its beginning; the unskilled is waiting to receive what is, if he did but know it, redundant information. Literally, then the skilled man has more time to act . . ."

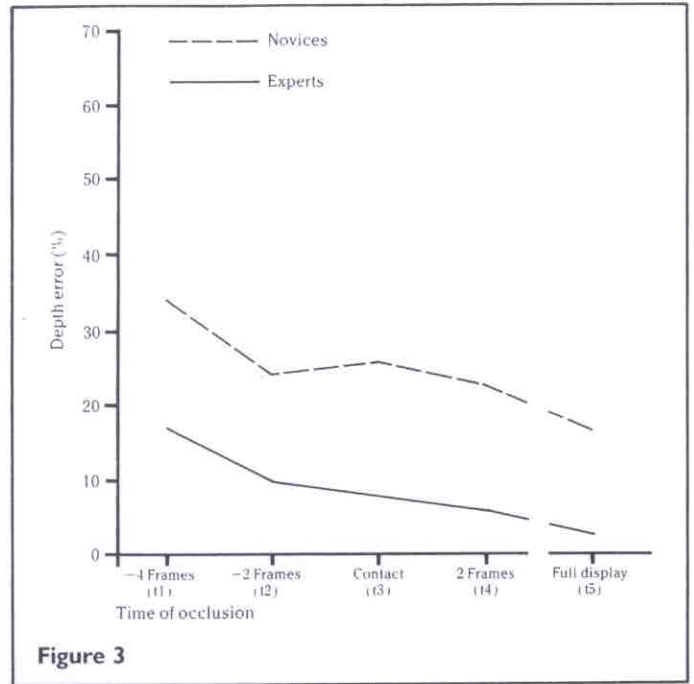
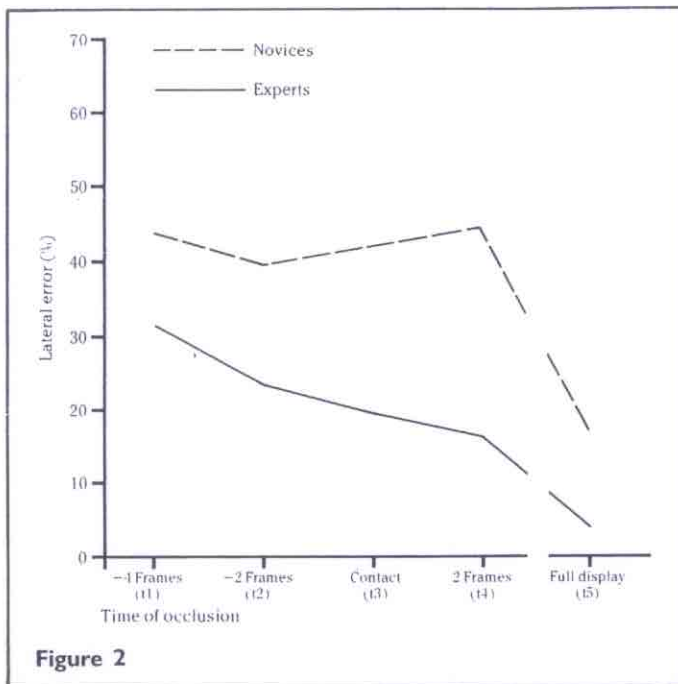
(pp 114-115)

How might expert and novice players use these sources on information differently?

These two sources of advance information provide two possible avenues to explain how the superior anticipation of the skilled racquet sport player which can be observed in field settings (eg Howarth et al, 1984) might originate. The first possibility is that the expert player's may have a greater awareness of probability information than novices simply because of their greater exposure to racquet sport events. The expert's familiarity with the frequency and sequence of events in their particular racquet sport may allow them to make better "best-bet" judgements about forthcoming events than can novices. There is some limited evidence available to indicate that the expert performers estimates of event probabilities more closely approximate actual event frequencies than do the estimates made by lesser skilled performers (Cohen & Dearnaley, 1962).

The second possibility is that the expert players may be able to use the advance postural cues available from the opponent's action more successfully than can the novices. This latter possibility was investigated in a 1986-87 Australian Sports Commission Applied Sports Research Project on squash players. The purpose of this research was to determine both (i) the specific visual cues which provide reliable anticipatory information in squash and (ii) the nature of any expert-novice differences in anticipatory cue usage.

Sixteen expert squash players (mainly from the AIS unit in Brisbane) and 20 novice players participated in the study. The subjects were initially shown a film of an opposing player executing a series of squash strokes with this film taken from a position corresponding to the defensive players normal recovery position on the "T". Each of the film trials (individual strokes) were cut-off at selected time periods both before and after the opposing player's contact with the ball and the subjects were asked, under all conditions, to predict the direction (cross-court or down-the-wall) and force (drive

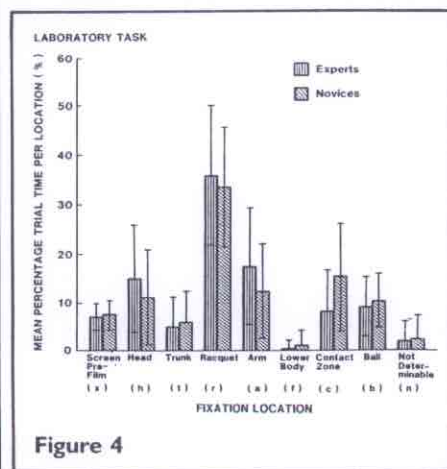


or drop shot) of the stroke. We found that in both the prediction of stroke direction and force that the performance of the expert players was markedly better than that of the novices across all cut-off conditions (see Figures 2 and 3) indicating that the skilled players could pick up more information from the early actions of their opponent than could novices. Even when the opponent's stroke was cut-off more than 160 milliseconds before they hit the ball (see condition t1 in Figure 2) the expert players were able to anticipate the opponent's stroke well above chance levels. (If the subjects were just guessing the errors would be around the 50% mark or higher).

By looking at the changes in performance across the various time intervals (eg from t1-t2, t2-t3 etc) we were able to imply that the main gains in accuracy regarding the prediction of the stroke outcome accompanied movement of the opposing player's racquet and especially the arm holding the racquet (in the period from 160 to 80 milliseconds before the ball is struck). Experts varied from novices in that they were able to use these cues for predicting both stroke direction and force whereas novices could only pick-up information about the force of the opponent's stroke from these early cues. In both cases experts picked up more advance information from these cues than did novices. These findings showing a greater ability of expert players to derive information from earlier events in the stroke sequence (the movements of the opposing player's arm and racquet) were consistent with findings from an earlier similar study using

Commonwealth Games-level badminton players (Abernethy & Russell 1987a).

The subject's eye movements were also recorded as they performed this film task using a sophisticated device which allowed us to determine at any particular time the point on the film at which the subjects were directly looking. No differences in the distribution of the subject's fixations (the periods when the eye is stationary and visual information is "taken in" from the environment) were found between experts and novices (Figure 4) nor were any differences found in the rate at which experts and novices moved their eyes around the display. This suggests that novices are not inferior to experts in their anticipation simply because they are not looking at the "right" cues — rather novices look at the important cues as much as do experts but they show a reduced capability to pick-up or use the potential information which is available from them.



In squash these important advance cues, as evidenced both from the film task results (Figures 2 and 3) and the fixation data (Figure 4) are the movements of the opponent's racquet, the arm holding the racquet and perhaps also the opponent's head. These advance cues are similar to those also found to be important in badminton (Abernethy & Russell, 1987b).

Some implications for improving anticipation

The results of this research project suggest some important implications for teachers and coaches intent on trying to improve the anticipatory skills of their players.

Firstly it should be noted that the marked differentiation of the expert and novice players on the film task used in this study clearly illustrates the importance of anticipatory skill in determining squash playing proficiency. Quite simply better players are characterized by a greater ability to anticipate stroke outcome from early postural cues (even within the expert group a high correlation was obtained between prediction performance and the World and national rankings of the players). Given this close relationship between skill level and ability to use advance cues it is clear that every attempt should be made to develop systematic training procedures for improving anticipation, just as there are currently such procedures for improving more obvious skill components such as stroke technique and fitness.

The results of the eye movement analysis show that it will be insufficient, in attempting to improve the anticipation of

lesser-skilled players, to merely instruct these players to focus more on the arm and racquet action of their opponent, as the lesser skilled players currently fixate on these critical cues as much as do experts. Similarly having players view and model the visual search patterns of expert players is also unlikely to be a beneficial strategy. Rather players must learn the relationship between early advance cues (such as the position or speed of movement of the opponent's elbow) and the resulting stroke direction and force if their anticipatory skills are to be improved. Some useful techniques to enhance this perceptual learning might involve:

(1) careful explanation to players of the simple biomechanical relationships between racquet head angle and the resultant stroke direction and of the notion of proximal to distal transfer of momentum (and hence the awareness that proximal arm cues will always precede distal racquet cues). (See for example Elliott, 1979 for a simple discussion of the kinematics of some common racquet sport strokes).

(2) the development of anticipatory training films, similar to those used in this project, which require players to anticipate the opponent's stroke from vision of only advance cues. Given the ready access many coaches have to videotape individual coaches could easily create their own training tapes tailored specifically to the skill level and anticipatory problems of their players simply by videotaping the action of another player from an on-court perspective (ie using the camera to reconstruct the normal view of the receiving player). There are some examples from tennis (Day, 1980; Jones, 1972; Haskins, 1965) and baseball (Burroughs, 1984) to suggest that these film training procedures are beneficial. Certainly this specific approach is more likely to improve the perceptual performance of the players than are generalized eye training programs (Abernethy, 1986).

Some additional procedures for improving anticipation based on the use of colour coding of key cues are also worthy of consideration by the innovative coach (see Maschette, 1980).

Finally, although not directly tested in the research project, there would appear to be an obvious need for players particularly at top levels of competition to study in detail the game strategies of their major opponents such that appropriate

knowledge of event of probabilities (favoured strokes, plays, options etc) can be developed prior to actual match play. This analysis of the opponent's play can be again augmented through the use of the video recorder, this time in conjunction with one of the various "user-friendly" computer programs now available to quickly generate match statistics on such items as stroke frequencies, success ratios from different stroke types etc (eg See Franks, Goodman & Miller, 1983; Patrick & McKenna, 1986). In conclusion it should also be pointed out that the procedures outlined here would seem pertinent for all racquet sports and, in a more general sense, for all fast ball sports where the anticipation of the opponent's action is essential for successful performance.

Acknowledgements

The research reported here was kindly funded by the Australian Sports Commission through its Applied Sports Research Program. Appreciation is extended to John English for assistance with the data collection on this project and to the squash unit of the A.I.S. for the provision of the expert subjects.

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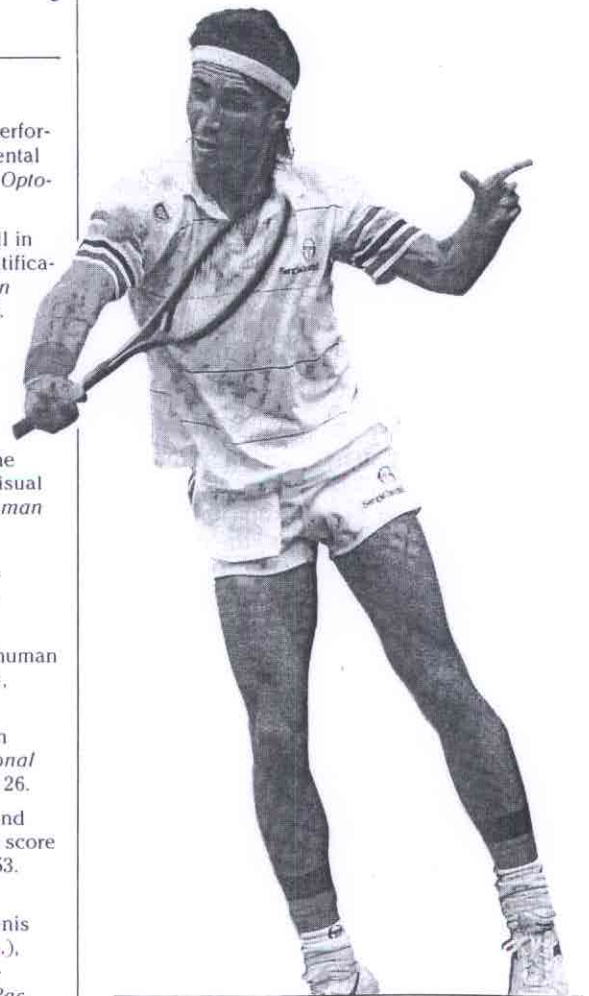
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