

## **A Preliminary Investigation into the Validity of Shadowing as a Response for Table Tennis Cue Utilisation Experimentation.**

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### **Abstract**

Investigations into the cue utilisation characteristics of table tennis players (e.g. Morris and Hunter, 1989) and in many other sports (e.g. badminton, Abernethy and Russell, 1987, ice hockey, Salmela and Fiorito, 1979 and tennis, Jones and Miles 1978) have up until now used methods of subject response that place no realistic time constraints or include any real ecological validity. This questions the validity of the conclusions made from such work and has caused researchers in the field to look for a more ecologically valid experimental design to investigate such an essential element in fast ball sports where anticipation would seem to be a prerequisite for top class performance.

Abernethy (1987) called for such a move but very little progress has been made, with researchers still dependent upon tight experimental designs that address the questions that need to be asked but are not really adequate to answer those same questions.

The method for testing involved subjects responding to balls propelled from a ball firer under each of four conditions. In only one of these conditions did the subjects actually have the opportunity to hit the ball. These responses were used in the analysis as a baseline for comparison. The baseline comparison was made against all of the other three conditions where the subjects were stopped from actually hitting the ball. This was achieved by strategically placing pieces of glass on the table that stopped the ball at different points in its flight path, thus decreasing depth cues available for use in selecting an appropriate response. Subjects were marked with joint centre markers placed at the shoulder, elbow and wrist joints on the playing arm.

Results show significant differences for the main effect of condition. Closer inspection of the intra individual data shows a trend, with the conditions creating the most difficult depth perception environment causing the greatest variation in shadowed response. Non significant data was found for the height variable indicating that the invariance in height characteristics in a true game situation was easily replicable in a shadowed response.

In conclusion, although this study was a preliminary one, the data indicates that subjects could carry out a shadowed response which was a relatively 'good' approximation of the actual response demanded in a real game. Clearly this technique provides advantages over those previously used and places subjects under real accuracy and time constraints akin to a real response structure.

Key words: shadowing, cue utilisation, ecological validity

## **Introduction**

The playing of fast ball games such as table tennis, submits the participants to time pressures of the highest order and produce a very complex perceptual display to which a highly accurate perceptual and motor response must be given.

Within sporting situations in general, and more specifically in fast ball sports, the need for anticipatory skills is paramount. Researchers in Sport Science have been keen to investigate the components of different sports which may constitute anticipatory cues and produce work that "would appear to be not only of future theoretical importance but also of considerable practical value to the teacher and coach." (Abernethy, 1981, p14)

The work investigating this area of motor skills has been approached in many methodologically different ways.

Possibly the most encouraging area for an analysis of anticipatory skills was that of visual search. Many researchers have looked into this aspect in sports such as tennis (10), basketball (6), badminton (5) and volleyball (15).

Many of the above investigations have looked at expert/novice differences and there have been vastly differing conclusions with some distinct differences found (6) whilst others found the results comparing skill level indistinguishable (5). These differences may well stem from the methodological constraints of the equipment used to record eye movement in many of these studies, the NAC Eye Mark Recorder. There are many problems with this piece of equipment that make its use in anticipation experimentally difficult. Calibration problems, the ignoring of the well documented use of peripheral vision in sporting situations and the determining of the exact point of focus of the subject, make it exceedingly difficult to draw meaningful conclusions from experiments using such equipment.

The second, and most commonly used method for the analysis of anticipation is that of occlusion. This technique employs periods of time or space (temporal or spatial) where no visual display is available to the perceiver. By this method the areas of the display, in terms of time or specific features, can be manipulated and the effects analysed.

Much of the pioneering work in the use of occlusion periods was carried out in the late 1960's and 1970's by Whiting and his co-workers in the field of catching (e.g. (16)).

In a more sport specific environment occlusion methods have been used to identify the time periods or spatial elements important for successful performance in much the same way as Whiting proceeded. Differences occur in the method of occlusion and the form of subject response. The occlusions consist of 'blacked out' portions of an overall stimulus, displayed in the form of video or cine film. The response, in many of the experiments, was an estimation of the bouncing or landing position which the subject identifies on a scale drawing of the respective court area.

Many sport situations have been investigated using this method including tennis ((13),(8)), squash (2), badminton (4), table tennis (14), and volleyball (17) to name but a few.

These experiments clearly have a laboratory based structure. In contrast to this, field testing of anticipatory capabilities has been attempted (12) in squash. This particular experiments' strength was the attempt to establish the highest form of ecological validity possible. This was accomplished by the analysis of anticipatory movements in actual matchplay situations.

The concept of ecological validity has come very much to the forefront of sport psychology and it is clear that " the more exact the replication of actual behavior patterns in controlled and specific settings, the greater the credibility in the application of accrued data." (Davids, 1988, p127)

As is clearly evident from the profusion of research using laboratory based experimental designs in comparison to field based studies, there is much need for a movement towards ecologically valid paradigms.

As Abernethy, B. (3) states "Realistic assessment of cue usage from laboratory tasks is only possible if ecologically valid time constraints are maintained." (Abernethy, Otago, p 115)

Holder and Collins (11) approached temporal cue utilisation in table tennis services using an experimentally robust stimulus video presented to table tennis players who responded as they would in a game with full body movements and in real time," to ensure that ecological validity (was) maintained for not only the perceptual aspect of the skill, but also for the motor aspect." (Abernethy, Otago, p111)

The motor response was termed a shadowed response and describes a full response but one where a ball was not hit. Expert/Intermediate player differences were found for some variables under the different occlusion conditions. The use of this response in cue utilisation experimentation has not been validated in a formal manner but from such a preliminary undergraduate study the results indicated further investigation was merited.

The strength of such an experimental paradigm is that it is an attempt to achieve" a notional balance between scientific merit and applied relevance." (Davids, 1988, p128)

Such a balance is sought once more within the present work.

## **Methods**

Five England International players completed the testing protocol. The method for testing involved subjects responding to balls propelled from a ball firer under each of four, crossed conditions (Fig 1). In each condition subjects received twenty trials, ten of which were test trials and ten "dummy" trials which were used to provide variation in positioning and to maintain subject motivation. In only one of these conditions did the subjects actually have the opportunity to hit the ball. These responses were used in the analysis as a baseline for comparison of bat/ball contact. Within the three other conditions subjects were stopped from actually hitting the ball. This was achieved by strategically placing pieces of glass on the table to stop the ball at different points in its flight path. Subjects were required to complete a shadowed response to these test conditions that comprised the physical action that they would carry out if there were a ball to hit. This was an attempt to mimic, and investigate the effects of, the decreasing depth cues available for use in selecting an appropriate response within video presentation of stimuli.

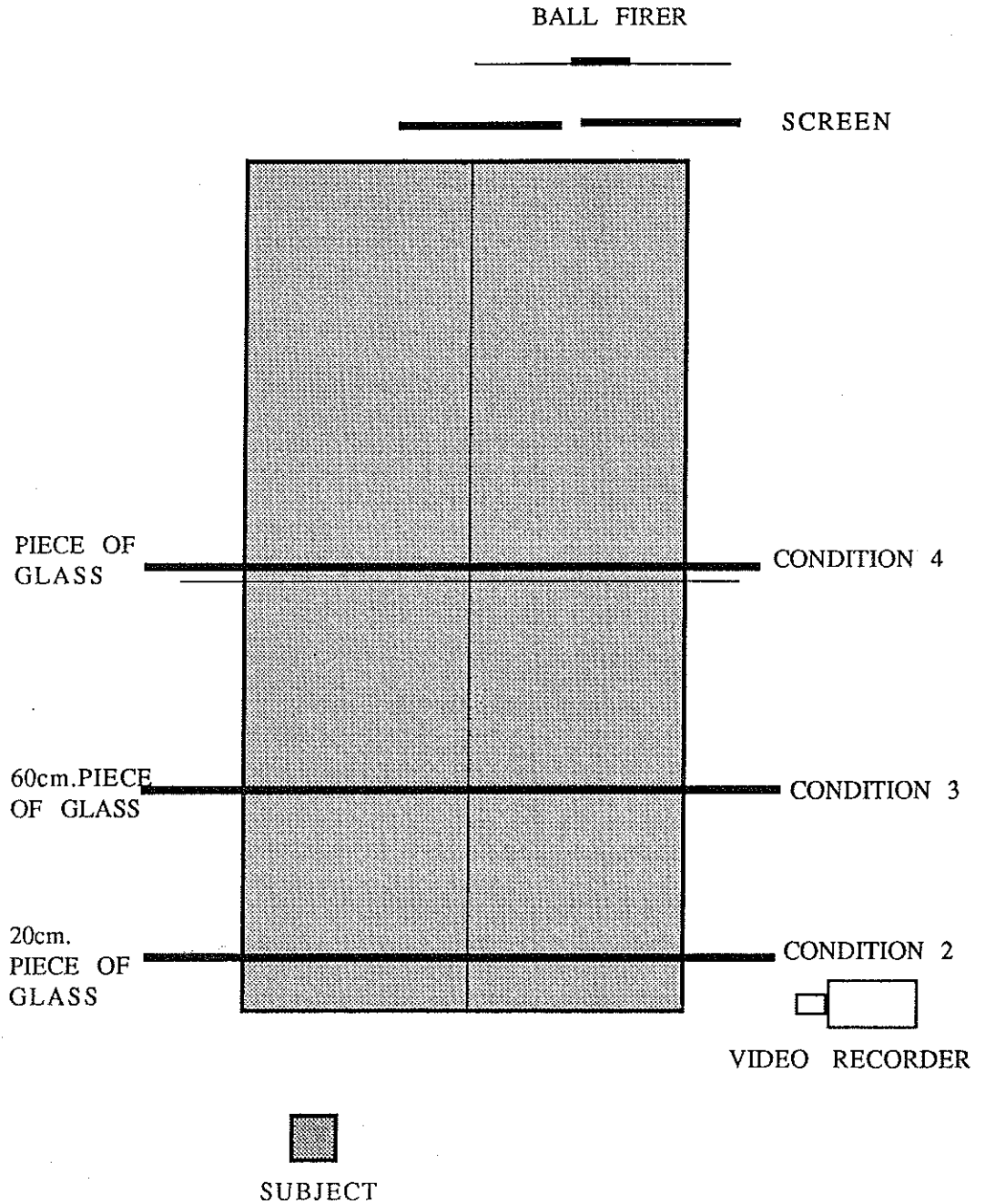
The analysis was partly based on the work completed by Bootsma and van Wieringen (7) where invariants in response to structure of table tennis strokes of experts were noted. Invariability across conditions was examined in terms of the first forward motion and contact between bat and ball. The analysis was completed on a For - A Video Position Analyser using a Panasonic NVF 75S video cassette player capable of analysing 50 fields per second. X - Y co-ordinates were measured and intra-individual differences between responses to the four testing conditions outlined above, were analysed by the use of a series of one way Analyses of Variance. Variations in the motor response is assumed to result from the perceptual difficulties created by the diminished depth cues in the shadowing conditions.

## **Results**

Table 1 below shows the significance levels for each subject for the five areas of analysis i.e. First movement forward - depth (X - co-ordinate), first movement forward - height (Y - co-ordinate), field when first movement forward occurred, contact point - depth (X - co-ordinate) and contact point - height (Y - co-ordinate).

Clearly subjects found assessment of height less of a problem than depth. This is what would be expected as vertical variations are less apparent in table tennis than are variations in the horizontal plane. The significant results for height at contact can be

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explained by the effects of the last condition (Condition 4) where many subjects shadowed too early or too late resulting in poor comparable height measurements.

From visual inspection of the data it is clear that a large proportion of the significant data was caused by the most difficult depth perception condition (Condition 4).

### **Conclusion**

Clearly further data needs to be collected before any firm conclusions about the true potential of the shadowing response can be made. This preliminary study does indicate that, with depth cues of a similar magnitude to those given from a video presentation, shadowing response structure closely approximates the motor component occurring when a ball is struck.

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**Table 1**

Sub	First Movement Forward			Contact	
	X-co-ordinate Depth	Y-co-ordinate Height	Video field	X-co-ordinate Depth	Y-co-ordinate Height
1	p=0.0367	N.S.	p=0.0000	p=0.0001	p=0.0000
2	p=0.0010	N.S.	N.S.	p=0.0113	p=0.0034
3	N.S.	N.S.	p=0.0002	p=0.0018	p=0.0033
4	p=0.0001	N.S.	p=0.0014	p=0.0001	p=0.0013
5	p=0.0018	p=0.0000	p=0.0000	p=0.0000	p=0.0000