Vision In Action Strategies Involving Experienced and Inexperienced Softball Umpires

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INTRODUCTION

Players, coaches, and fans place their ultimate confidence in that of an umpire's call accuracy. An umpire needs a specific strategy to call strikes and balls as precisely as possible. This strategy is critical because the umpire has a difficult job that requires fast decision-making. What is this strategy? What separates elite from novice umpires?

Some studies have been performed to compare the vision in action strategies of elite and novice athletes in various sports such as ice hockey and Olympic speed skating. These studies were conducted using the ASL Mobile Eye Tracker. Vickers et al. (2004) examined the gaze characteristics and strategy differences between elite and novice ice hockey players. A significant difference was found between elite and novice players' fixation location and duration patterns. Vickers et al. (2006) studied the gaze strategy of Olympic speed skaters and location of gaze on the ice. Significant differences in strategy were identified between elite and near-elite speed skaters. Few studies have been completed involving the strategy of softball umpires.

Information regarding the strategy of an umpire would greatly benefit softball. More precise training techniques for novice umpires could be identified. Therefore, the purpose of this study is to compare the visual strategies of novice and elite softball umpires to determine if a vision in action strategy exists for accurately calling pitches. The hypothesis of this study predicts that the strategy of elite and novice umpires are significantly different.

METHODS

This study was conducted over a three-month time period. Data collection occurred in a one-day time period.

Participants

Two elite and two novice umpires were recruited. Novice umpires had less than three seasons of experience whereas elite umpires had three seasons or more. All umpires were tested for vision by the Optic 2000 Eye Tester and found to have normal contrast sensitivity and 20-20 static acuity. A hitter, pitcher, and catcher were recruited from the UMD Varsity Softball team.

Materials

A regulation softball field was simulated inside Ward Wells Field House at UMD. Regulation softball, bat, gloves, and protective equipment were used as well as a regulation batting cage. The umpire wore regulation padding and an approved mask. An external camera was used to capture and record the motor phases (Table 1) of the pitcher, hitter, catcher, and umpire. An ASL Mobile Eye Tracker was placed beneath the mask of the umpire to capture the gaze phases (Table 2) of the umpire.

Data Collection

The ASL Mobile Eye Tracker (Pictures 1 & 2) was calibrated to the specific dimensions of the umpire's eye. The gazes were recorded using this equipment. The external camera recorded the motor phases of the action scene. The type of pitch and whether the batter should swing or not swing was predetermined; all were cued except for the umpire (Picture 3).

Quiet Eye Solutions was instrumental in capturing the gazes of the umpires. The videos from the external camera and the ASL Mobile Eye Tracker were synchronized to reveal where the umpire's eye fixated, when the umpire announced the call, and any other motor action involved in determining balls and strikes.

Data Analysis

Ten trials from each umpire were then coded. Each trial began 120 frames before the umpire's call which was exactly 4,000 Msec. Trials were selected based on call accuracy and quality of pitch, with preference given to the balls that were not hit. Each motor phase was coded followed by each gaze phase. Data was analyzed using StatView software.

Table 1: Motor Phases

Motor Phases	Description
Pitcher preparation (Pp)	Ball in glove to out of glove
Pitcher Wind-up (Pw)	Ball out of glove to backswing of arm
Pitcher Throw (Pt)	Backswing of arm to just before ball out of hand
Pitcher release (Pr)	Ball out of hand
Pitcher Ball Flight (Pbf)	Ball out of hand to catcher's glove
Umpire Signal (Us)	Ball in glove to umpire's call

Table 2: Gaze phases

Gaze	Description
Fixation	Continuance of the gaze for a set period
Tracking	Fixation on a traveling object
Saccade	Rapid eye shift
Blink	Eye blink

Picture 1: Gaze and Motor Views

Picture 2: Umpire with Mobile Eye Tracker

Picture 3: Data Collection

RESULTS

Umpire Call Duration

There was a significant difference between elite and novice call duration (T=2.025, p=0.0499) which indicated that elite umpires took longer (M=1000 Msec) to make a call than novice (M = 850 Msec). The elite umpires on average took longer to make a call than the novice umpires.

Gaze location during ball flight

There was a significant difference between elite and novice umpires' abilities to track the ball during flight ($F_{1,38}$=3.33, p=0.04). The elite umpires' pursuit tracking of the ball during flight was 87.6% of the total flight compared to 71.6% for the novice umpires. An additional repeated measure ANOVA analysis (type x phase x trial) was performed to determine if the duration of the 5 motor phases were different. No significant difference was found between the two different types of umpires ($F_{1,38}$=0.04, p=0.82). This analysis determined that ball flight phase and flight duration were similar for all trials involving both elite and novice umpires.

Gaze behavior by location and phase

During the Pp phase, both the elite and novice umpires' gaze locations were on the ball (40%) or pitcher's head. The elite were on the pitcher's head 30% versus the novice with 40%. During the Pw phase, the elites' gaze locations were the pitcher's glove (50%) or pitcher's arm whereas novices' gaze locations were the pitcher's glove (45%) or pitcher's torso (30%). During the Pt phase, the elites' gaze location was the pitcher's torso (55%) compared to 75% for the novice umpires. During the Pr phase, the elites' gaze location was 100% on the ball whereas the novices' gaze location was 55%. A repeated ANOVA (type x phase x trial) indicated the elite umpires were significantly better in fixating on the ball at the pitcher's release point than novice umpires ($F_{1,38}$=8.8, p=0.005).

Gaze and fixation count

The eye activity was analyzed between elite and novice umpires for various gaze locations ($F_{1,38}$=1.59, p=.21) as well as number of fixations ($F_{1,38}$=0.01, p=1.0). It was determined that eye activity was similar between elite and novice umpires. Both were similarly inactive (quiet).

DISCUSSION

Eye tracking technology was used to determine the strategy involved in elite and novice umpires' calling accuracy. This was the first time an eye tracking device had been placed on an umpire. Data supports the hypothesis that elite and novice umpires have different strategies. Elite umpires were found to have an individualized strategy during pitcher preparation. The elite were able to identify the release point on nearly every trial and were also able to track the ball the entire distance during flight. The elite took significantly longer to make a call.

The novice umpires differed from this strategy; they had a specific fixation strategy during the pitcher's preparation. However, they were not able to identify the release point or track the ball the entire distance during flight. The novice also made a call in less time than the elite umpires did. This research is critical to identifying the strategy of an umpire and may contribute greatly to the training of novice umpires in the future.

REFERENCES

Martell, S. & Vickers, J.N. (2004). Gaze characteristics of elite and near-elite ice hockey players. Human Movement Science, 22, 689-712.

Vickers, J. N. (2006). Gaze of Olympic speed skaters while skating at full speed on regulation Oval. Cognitive Processing, 7, 1, 102-105.

Harle, S. & Vickers, J.N. (2001). Training quiet eye (QE) improves accuracy in the basketball free throw. The Sport Psychologist, 15, 289-305.

Vickers, J.N., Rodrigues, S.T. & Edworthy, G. (2000) Quiet eye and accuracy in the dart throw. International Journal of Sports Vision, 6, 30-36.