

EYE MOVEMENTS AND LIMB KINEMATICS IN MOVING TARGET AIMING

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INTRODUCTION: Previous eye movement studies in far target aiming have shown that a longer final eye fixation right before movement initiation results in enhanced performance accuracy (e.g., Vickers, 1996). Previous studies have been limited to fixed target aiming. In the present study eye movements were measured while participants attempted to intercept a moving target. The identification of the relationship between eye movements and limb kinematics in moving target interception will provide further understanding of perception-action coupling in rapid intercepting movement.

METHOD: Right-handed adults volunteered after giving informed consent. The task was to intercept a moving target by throwing a dart to a projection screen where the target was viewed. Three different target speeds were used. Participants attempted to hit the middle of moving target as it crossed a fixed target location. The darts were thrown using a discrete forearm extension. The target was projected on a projection screen (4.1 m length) and the participants stood 2.36 m from the projection screen. The target height was 1.72 m. An Eye-tracking system (Applied Sciences Laboratories 501) with accuracy of $\pm 1^\circ$ and precision of 0.5° of visual angle was used to measure the line-of-gaze. The system sampled at a rate of 60 Hz and point of gaze was updated for each frame of video (every 33.3 ms). Three event times were recorded using a timer (Lafayette, 54035A): movement initiation, dart release, and dart landing. Twenty trials at each target condition were performed.

RESULTS: Fixation time and outcome accuracy were the primary data of interest. These data are available in Table 1 below.

Table 1 Fixation Time and Spatial-Temporal Error

Target Speed (mm/s)	Mean Fixation Time before Final Fixation (ms)	Final Fixation Time (ms)	Temporal Error (s)	Spatial Error (mm)
732	0.24 \pm 0.05	0.21 \pm 0.05	0.03 \pm 0.02	24.88 \pm 15.42
1464	0.17 \pm 0.03	0.13 \pm 0.04	-0.03 \pm 0.02	-48.19 \pm 32.08
2193	0.16 \pm 0.03	0.11 \pm 0.03	-0.06 \pm 0.01	-121.5 \pm 26.8

DISCUSSION: The final fixation time before movement initiation was shorter than the mean fixation time regardless of the target speeds. Both mean and final fixation time became shorter as the target speed increased. Increased target speed produced a kinematic bias of movement production in that the participants tended to lead the moving target at slow target speed and lagged the target at faster target speeds.

In conclusion, the results from this study are inconsistent with previous studies that have shown that final fixation times are generally longer than other fixations and that trials with longer final fixations have smaller spatial and temporal errors. Due to the task requirement of tracking the speed of the target motion, the increased role of visual guidance in moving target intercepting resulted in the increment of spatial-temporal errors as the target speed increases.

REFERENCES:

Vickers, J.N. (1996). Visual control when aiming at a far target. *Journal of Experimental Psychology: Human Perception and Performance*, 22(2), 342-54.