Increasing Character Size and Length of Presentation Improves Both Accuracy and Reaction Time of a Dynamic Visual Acuity Task

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Introduction

The vestibulo-ocular reflex (VOR) generates eye rotation to compensate for potential retinal slip in the specific plane of head movement. Dynamic visual acuity (DVA) has been utilized as a functional measure of the VOR. The purpose of this study was to examine how both accuracy and reaction time varied in a DVA character orientation recognition task with different sizes of computer-generated characters and different lengths of presentation time.

Methods

Visual acuity was measured in 12 healthy subjects as they moved a hand-held joystick to indicate the orientation of a computer-generated Landolt C “as quickly and accurately as possible.” Acuity thresholds were established with optotypes presented centrally on a wall-mounted LCD screen at 1.3 m distance, first without motion (static condition) and then while oscillating at 0.8 Hz (DVA, peak velocity 60 deg/s). Acuity was also measured using a standard wall chart at 3 m distance. All acuity measures were made using a forced-choice strategy, and determined by the smallest size in which the subject answered correctly in 3 of 5 responses.

Subjects started each session with a familiarization run with the joystick, receiving visual feedback with each response. The reaction time was then measured with random targets presented in each direction. The joystick responses alone ranged in the 500 to 700 msec range, and did not differ with direction.

Results

Dynamic acuity was reduced relative to static acuity in 7 of 12 subjects by one step size. Reaction times were greater during dynamic motion versus no motion (static condition).

The optotype size (logMar 0, 0.2 or 0.4, corresponding to Snellen range 20/20 to 20/50) and presentation duration (150, 300 and 450 ms) were counter-balanced across five trials, each utilizing horizontal rotation at 0.8 Hz. During the random target trials, both accuracy and reaction time improved proportional to optotype size. Accuracy and reaction time also improved between 150 ms and 300 ms presentation durations.

Conclusions

DVA has typically been used as a functional measure of vestibulo-ocular reflexes using accuracy alone. However, accuracy and reaction time during a DVA task may better reflect the higher order neural processing involved, and the speed-accuracy tradeoffs that are present during sensory impairment. Our main finding was that accuracy and reaction time co-varied as a function of the target size and location as well as length of presentation. This study demonstrates how accuracy and reaction time can be used together to functionally assess measures of gaze stabilization during a target recognition type task.

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