I. Introduction

The time that elapses between stimulus onset and the onset of a saccadic eye movement is longer and more variable than can be explained by neural transmission times and synaptic delays (Carpenter, 1981). In theory, factors underlying oculomotor response-time (RT) variability could arise at any point along the sensorimotor cascade, from early sensory noise (Green and Swets, 1966; Osborne et al., 2005) to noise in the motor criterion necessary to trigger a response (Grice, 1968). These alternative loci for internal noise can be distinguished empirically (Stone and Krauzlis, 2003). When shared visual internal noise dominates, saccadic response time will correlate with perceived stimulus magnitude whereas when unshared noise sources dominate, no such correlation will be observed.

II. Methods

![Image](https://ntrs.nasa.gov/search.jsp?R=20110011076)

**Task Parameters:**
- Background luminance: 37.6 ± 8.2 cd/m²
- Target eccentricity: 6°
- Fixation diameter: 0.0°
- Sample-image duration: saccadic latency
- Test-image duration: 250 ms
- Target signal strength (SNR): 5.5:1
- Distactor signal strength (SNR): 4.2:1

**Procedure:**
- Prior Probability (5 observers): 0.25, 0.5, and 0.75
- Reward Schedule (3 observers): 0.1, 0.3, and 0.9

**Psychometric functions:**
- Background luminance
- Target eccentricity
- Fixation diameter
- Sample-image duration
- Test-image duration
- Target signal strength (SNR)
- Distactor signal strength (SNR)

**Psychometric functions for trials designated as either the faster or slower twin.**

An analysis using twp presentations of an identical set of stimuli rules out the possibility that the observed correlations arise from variability in physical signal strength.

III. RT-triggered psychometric functions

For each subject, we binned the response-time distribution and defined the mean of each psychometric function as perceived brightness.

Although this analysis examines the relationship between perceived brightness and overall system noise in saccadic response rate, it does not distinguish between external (stimulus) and visual (neural) noise.

IV. Controlling for external noise

For each subject, we plotted the relationship between response rate and signal strength and defined internal noise as the orthogonal distance between each point and the external noise regression.

We then quantified perceived brightness changes as a function of internal noise, which were always positive (mean: 0.32, SD: 0.19, p < 0.05 for 8/8 cases, bootstrap test).

VI. Conclusions

Variability in saccadic response rate correlates with perceived brightness, consistent with a shared noisy visual input altering both in parallel.

Coupled trial-by-trial variability in perceived brightness and oculomotor reaction time cannot be accounted for simply by variations in physical signal strength. Thus, in our saccadic 2 AFC task, a dominant shared source of early neural visual noise jitters both the percept and oculomotor response in parallel as has been shown with smooth pursuit responses (Stone and Krauzlis, 2003).

The early visual noise source can be modeled as Gaussian variability in the rate of rise of the decision variable (Carpenter, 1981).

**References**


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Direct Relationship Between Perceptual and Motor Variability

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