Monkey and human performance in a chronostasis task suitable for neurophysiology

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Abstract

Psychophysical studies suggest systematic changes in the perception of brief durations around the time of eye movements. Specifically, perceived time is elongated just after a saccade (i.e., "chronostasis"). Chronostasis has been demonstrated in a number of studies but little is known about the neural bases of this saccade-induced duration illusion. We trained a monkey to discriminate whether interstimulus intervals (ISIs) ranging from 50–250 milliseconds (ms) were shorter or longer than a learned reference duration of 150 ms. Stimuli consisted of two spatially-identical, successive flashes of light. The monkey first made a single saccade to a fixed target location. In most trials ("baseline"), the interval appeared 700 ms after saccade offset. The monkey then reported whether the ISI was shorter or longer than the reference duration by making an eye movement to one of two choice targets. To test for time illusions, in a small percentage of trials, stimuli were presented just after saccade offset (10–500 ms). The monkey’s choices during these trials were compared to those in the baseline trials. As predicted, the monkey increasingly overestimated the duration of a given ISI as the postsaccadic presentation time decreased. Intervals presented just after saccade offset (10 ms) were perceived as lasting roughly twice as long as the same intervals presented during baseline conditions. We have begun investigating human duration discrimination using the same neurophysiologically-compatible paradigm, which will allow us to validate the apparent duration illusion seen by our monkey and make cross-species comparisons for follow-up studies. Given the integral role of the neural circuitry between the frontal eye field and superior colliculus in maintaining visuo-spatial stability (Sommer and Wurtz 2006), it is likely that neuronal activity in these structures also plays a critical role in maintaining visuo-temporal stability around the time of eye movements. Future work will directly test this hypothesis.

Footnotes

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