Displacement Affects Duration Estimation, But Not the Other Way Around

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Introduction

How do we mentally represent and reason about domains for which little sensory information is available? One suggestion is that our understanding of abstract domains is intimately dependent on our understanding of richer, more experience-based domains (Boroditsky, 2000, 2001; Gentner et al., 2001; Gibbs, 1994; Holyoak & Thagard, 1995; Lakoff & Johnson, 1980, 1999). For example, people's understanding of time appears to be dependent on spatial knowledge (Boroditsky, 2000; Boroditsky & Ramscar, 2002). Previous evidence suggests that there is an asymmetric relationship between the domains of space and time. Whereas spatial knowledge was found to be useful for reasoning about time, temporal knowledge did not facilitate spatial reasoning (Boroditsky, 2000).

The present studies investigate whether this asymmetric relationship between space and time holds even for low-level representations of the two domains.

In a series of simple psychophysical tasks, participants viewed a moving stimulus and estimated either its displacement or its duration. Results show that temporal estimates were strongly modulated by the displacement of the moving stimulus, even when participants were encouraged to attend selectively to temporal information. In contrast, spatial estimates were not modulated by the duration of the moving stimulus when instructions encouraged selective attention to spatial information. Spatial estimates were only weakly correlated with stimulus duration when participants were required to attend to both temporal and spatial information simultaneously.

Experiment 1

Methods

Moving lines were presented on a CRT monitor. Line durations and displacements were varied parametrically. Durations ranged from 1 to 5 seconds in 0.5 second increments. Displacements ranged from 200 to 800 pixels, in 75 pixel increments. Nine durations were fully crossed with nine displacements to produce 81 distinct lines. Lines 'grew' horizontally across the screen one pixel at a time, from right to left, at rates ranging from 40 pixels/second to 800 pixels/second. Each line remained on the screen until its maximum displacement was reached.

Participants viewed 162 moving lines, one line at a time. Immediately after each line event, a prompt appeared indicating that the participant should reproduce either its duration or its displacement by clicking the mouse to indicate the beginning and end of the estimated temporal or spatial interval.

Results

Participants' temporal and spatial estimates were highly accurate. Target duration correlated positively with estimated duration (r^2=0.96), and target displacement correlated positively with estimated displacement (r^2=0.97). The effect of target displacement on estimated duration (r^2=0.72) was greater than the effect of target duration on estimated displacement (r^2=0.36).

Experiment 2

Methods

Materials and design were exactly as described in Experiment 1. The procedure was identical with the following exception: in Experiment 2, participants were notified before each trial whether they would need to reproduce the duration or displacement of the moving line.

Results

Again, participants' temporal and spatial estimates were highly accurate. Target duration correlated positively with estimated duration (r^2=0.96), and target displacement correlated positively with estimated displacement (r^2=0.99). The effect of target displacement on estimated duration (r^2=0.82) was much greater than the effect of target duration on estimated displacement (r^2=0.01).

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