Abstract View

CAN THE VISUAL SYSTEM ACCOUNT FOR LATENCY DIFFERENCES?

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In a previous study (Eagleman & Sejnowski, Science, 2000), we demonstrated that visual perception seems to access incoming information from ~80 ms after an event before attributing a perceptual decision to the time of the event. This postdictive framework stands in contrast to the latency difference (LD) hypothesis, which suggests that the leading edges of signals race through the brain to perceptual end points. We here extend our examination of the LD hypothesis with several psychophysical experiments. Even at the early stages of the visual system, physiological latencies vary by about 80 ms between high- and low-luminace signals. Thus, using luminance as a parameter, we introduce several visual displays whose appearance should be predicted by LD. In one experiment, a moving square is defined by sequential frames of randomly-placed flashes. The flashes appear in a luminance gradient, from bright on one side of the square to dim (below threshold) on the other. The LD hypothesis predicts that since bright flashes are processed more quickly, the moving square should appear to expand when moving in one direction (and contract in the other direction). Surprisingly, no such illusion is seen by participants. To examine this further, we noted that many illusions seem to be well explained by LD: for example, two flashes, differing in luminance, can yield a sensation of apparent movement from bright to dim. We show that adding additional flashes, over a larger area, can reduce or abolish the illusion. Apparently, the abolition can come from the addition of contextual or 'higher level' information, which can only be explained by perceptual delay and postdiction, wherein the system waits for the slowest information to arrive before committing to a perceptual decision. These results suggest that the visual system normally allows the context of a scene to correct for latency differences. These experiments help us to address the underlying brain circuitry that could allow widely varying stimulus-evoked latencies to be reconciled with precise psychophysical temporal detection.