Multisensory Calibration Is Independent of Cue Reliability

A recent publication by ELSC-ICNC alumnus Adam Zaidel.

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Multisensory calibration is fundamental for proficient interaction within a changing environment. Initial studies suggested a visual-dominant mechanism. More recently, a cue-reliability-based model, similar to optimal cue integration, has been proposed. However, a more general, reliability-independent model of fixed-ratio adaptation (of which visual dominance is a subcase) has never been tested. Here, we studied behavior of both humans and monkeys performing a heading-discrimination task. Subjects were presented with either visual (optic-flow), vestibular (motion-platform), or combined (visual?vestibular) stimuli and required to report whether self-motion was to the right/left of straight ahead. A systematic heading discrepancy was introduced between the visual and vestibular cues, without external feedback. Cue calibration was measured by the resulting sensory adaptation. Both visual and vestibular cues significantly adapted in the direction required to reduce cue conflict.

However, unlike multisensory cue integration, cue calibration was not reliability based. Rather, a model of fixed-ratio adaptation best described the data, whereby vestibular adaptation was greater than visual adaptation, regardless of relative cue reliability. The average ratio of vestibular to visual adaptation was
1.75 and 2.30 for the human and monkey data, respectively. Furthermore, only through modeling fixed-ratio adaptation (using the ratio extracted from the data) were we able to account for reliability-based cue integration during the adaptation process. The finding that cue calibration does not depend on cue reliability is consistent with the notion that it follows an underlying estimate of cue accuracy. Cue accuracy is generally independent of cue reliability, and its estimate may change with a much slower time constant. Thus, greater vestibular versus visual (fixed-ratio) adaptation suggests lower vestibular versus visual cue accuracy.

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