

Stopping the clock

Our environment appears stable, even though we are continuously moving our head and body, and therefore, our sensory systems. We make brief saccadic eye movements every 200–300 ms throughout our lives, one of the most common motor acts performed, out numbering even the heartbeat by a factor of two. We also move our auditory apparatus during each head motion, and our tactile receptors – the skin – as we move our limbs. So there must be powerful perceptual mechanisms that integrate the changing sensory information caused by movements of the receptive systems and allow us to build up a percept of a stable world. A recent paper by Yarrow *et al.* [1] has examined a curious aspect of the integration of visual stimuli across saccadic eye movements: the percepts are ‘stretched’ backwards in time to overlap the initiation and execution of the eye movement, causing an illusion of a brief slowing down of real time, known as chronostasis.

Yarrow *et al.* asked subjects to move their eyes from a fixation point to a digital clock displayed on a computer screen,

which was set up so that the clock only started to display time in seconds as the subject initiated a saccade towards it.

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The clock initially displayed ‘0’ until the subject looked at it. Then, by artificially varying the duration of the first interval (the time the clock shows ‘1’) from 400 to 1600 ms, they were able to find the duration of this first interval that subjectively matched the duration of following, veridical, one-second intervals that were observed without further eye movements. The subjects made saccades of two amplitudes, taking an average of 72 or 139 ms to complete, and they judged the first interval as matching the following 1 s intervals if its duration was reduced to 880 or 811 ms, respectively. Adding the saccadic duration to the perceptual interval gives 952 and 950 ms compared to the true 1000 ms, so the subjects behave as if they perceive the first interval starting about 50 ms before their eye movement

towards the clock. It’s known that cells in the parietal cortex of monkeys spatially re-map their visual receptive fields about 80 ms before a saccade [2], so Yarrow’s data is in approximate temporal agreement with this. Of course, if the first interval is not artificially shortened, then there is a perceived slowing of the clock as one looks towards it – chronostasis that is sometimes obvious even when one glances at the ticking second hand of a normal clock face. Yarrow *et al.* also show that the illusion depends on active eye movements and on a stable spatial percept: if the clock is perceived to have shifted its position during the saccade, the illusion is lost.

- 1 Yarrow, K. *et al.* (2001) Illusory perceptions of space and time preserve cross-saccadic perceptual continuity. *Nature* 414, 302–305
- 2 Duhamel, J.R. *et al.* (1992) The updating of the representation of visual space in parietal cortex by intended eye movements. *Science* 255, 90–92

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Motion perception: tipping the microbalance?

Over the past 40 years, psychophysical and physiological research on motion perception has spawned a large number of computational models. Standard ‘low-level’ models extract motion directly from the time-varying luminance profile of the image, but are widely believed to be ‘blind’ to motion in ‘second-order’ stimuli (those in which motion is carried by cues such as texture variation).

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Of particular interest are a class of ‘microbalanced’ second-order stimuli in which the expected distribution of the power spectrum contains no directional information. Humans are able to see motion in microbalanced stimuli, leading to the proposal that we possess specialized mechanisms for detecting second-order motion. A recent paper by Benton and

Johnston [1] suggests that a re-evaluation of this proposal could be warranted. By analysing sequences of moving images in terms of local spatial and temporal gradients, they show that the motion of luminance-based and microbalanced stimuli can in principle be detected by a single mechanism.

The luminance profile of a moving image changes over space and time. The pattern of these changes is captured by the spatial and temporal gradients of the luminance profile. For each location in the image, the values of these gradients define the co-ordinates of a point in ‘gradient space’. For any given image sequence, the distribution of points in gradient space provides a novel and elegant representation of the information from luminance variations available to motion detector mechanisms. Benton and Johnston show that the gradient space representation captures the directional qualities of a range of microbalanced

second-order stimuli to which human observers are sensitive. Their results call into question much of the evidence purported to indicate multiple motion mechanisms, suggesting instead that a single luminance-based mechanism might suffice to explain a far wider range of phenomena than previously suspected. Although the authors are quick to point out that their results do not preclude a role for additional mechanisms such as attentional tracking of high-level features, they provide a refreshing challenge to the dogma that several distinct mechanisms (at least three in most accounts) are required to explain human motion perception.

- 1 Benton, C.P. and Johnston, A. (2001) A new approach to analysing texture-defined motion. *Proc. R. Soc. London B Biol. Sci.* 268, 2435–2443

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