

*This is an excerpt from a report on the Temporal Experience Workshop at the University of Toronto in May of 2013, written by Kevin Connolly, Mike Arsenault, Akiko Frischhut, David Gray, and Enrico Grube, available at [http://networksensoryresearch.utoronto.ca/Events\\_%26\\_Discussion.html](http://networksensoryresearch.utoronto.ca/Events_%26_Discussion.html)*

### **3. What sorts of mechanisms underlie the perceived duration of external events?**

A growing body of empirical evidence suggests that the various functions one might intuitively lump together under the heading “temporal experience”—judgments of simultaneity, duration, flicker rate, order, and others—are carried out by different mechanisms (Bayne et al., 2009: 629). We can then ask: How do these mechanisms, in particular those that underlie perceived duration, work?

According to the relatively standard pacemaker model, one part of the brain ticks in the manner of a pacemaker, while another part counts the ticks. An event’s perceived duration is a function of the number of ticks counted since its perceived onset. This model accounts for various duration illusions, such as the familiar experience of it appearing that perceived events have slowed down when one is afraid, in terms of a speeding up or slowing down of the pacemaker’s ticking.

But in his talk Ian Philips observed that the pacemaker model doesn’t provide a plausible answer to the question why the clock speeds up when we’re afraid. Philips suggests that what speeds up when we’re afraid is not the ticking of an internal clock, but the rate of our mental activity (which *is* readily explicable in terms of its adaptiveness). He then argues that when we’re afraid the perceived duration of events is modified because the perceived duration of external events is (or can be) determined *relative* to the perceived rate of our mental activity, so that if more is going on than usual in the mind’s eye, it might seem to one as though things outside the mind are going more slowly than usual. Lodging an objection like that which Philips raised against the simple pacemaker view, though, Geoff Lee observed that the correlation between the

rate of our mental activity and the perceived duration of external events might in turn be explained by their having a common cause, namely, an increase in brain activity generally.

Carla Merino-Rajme opts in her talk for a *subjective* pacemaker model of perceived duration, according to which chunks of the external world experienced as a temporal unity, or *quanta*, are themselves the ticks which, if attended to, contribute to an impression of their numerosity (or, are “counted”). The individual quanta are in turn bound phenomenologically to this impression of their numerosity: each is felt as a member of a series of quanta of a certain duration. Merino-Rajme argues that one of the advantages of this model over the standard pacemaker model is phenomenological: it explicitly incorporates a phenomenological relation between experiences of short-term durations (quanta) and experiences of long-term durations, or series of quanta.

Rather than making perceived duration a function of internal ticking, Alan Johnston proposes that the perceived duration of external events is determined by a content-contingent “pathway” or “mechanism.” Having conducted experiments in which he was able selectively to modify the perceived duration of events occurring in highly spatially specific areas of the visual field (to the exclusion of other areas), Johnston argues that rather than a central clock model we need a central decision procedure by means of which we can come to (a limited number of) temporal judgments on the basis of prediction and evidence from the various senses.

The theme of prediction, or of expectation, was also picked up in discussion of the oscillator model, defended by Diana Raffman (see Drake, Jones, and Baruch, 2000). According to this model, our ability to discern temporal features such as the relative durations of diverse aspects of complex stimuli (such as musical stimuli) is to be explained in terms of our brain’s having oscillators suited to becoming “entrained” to different sorts of temporal patterns. This

entrainment generates predictions that can then be compared to a reference oscillator. Although the pacemaker model has some advantages over the central clock model, the clock model was thought to provide a more straightforward mapping between durations and the way they're represented in experience than the oscillator model.

**References:**

Bayne, Tim, Axel Cleeremans, and Patrick Wilken, eds. 2009. *The Oxford companion to consciousness*. Oxford University Press.

Drake, Carolyn, Mari Riess Jones, and Clarisse Baruch. 2000. The development of rhythmic attending in auditory sequences: attunement, referent period, focal attending. *Cognition* 77.3: 251-288.