

UC Merced

Proceedings of the Annual Meeting of the Cognitive Science Society

Title

A Neurocomputational Model of Prospective and Retrospective Timing

Permalink

<https://escholarship.org/uc/item/6379f861>

Journal

Proceedings of the Annual Meeting of the Cognitive Science Society, 43(43)

Authors

de Jong, Joost

Voelker, Aaron R

Stewart, Terrence C

et al.

Publication Date

2021

Copyright Information

This work is made available under the terms of a Creative Commons Attribution License, available at <https://creativecommons.org/licenses/by/4.0/>

Peer reviewed

A Neurocomputational Model of Prospective and Retrospective Timing

Joost de Jong

University of Groningen, Groningen, Groningen, Netherlands

Aaron Voelker

University of Waterloo, Waterloo, Ontario, Canada

Terrence Stewart

University of Waterloo, Waterloo, Ontario, Canada

Chris Eliasmith

University of Waterloo, Waterloo, Ontario, Canada

Elkan Akyürek

University of Groningen, Groningen, Groningen, Netherlands

Hedderik van Rijn

University of Groningen, Groningen, Netherlands

Abstract

Keeping track of time is essential for everyday behavior. Theoretical models have proposed a wide variety of neural processes that could tell time, but it is unclear which ones the brain actually uses. Low-level neural models are specific, but rarely explicate how cognitive processes, such as attention and memory, modulate prospective and retrospective timing. Here we develop a neurocomputational model of prospective and retrospective timing, using a spiking recurrent neural network. The model captures behavior of individual spiking neurons and population dynamics when producing and perceiving time intervals, thus bridging low- and high-level phenomena. When interrupting events are introduced, the model delays responding in a similar way to pigeons and rats. Crucially, the model also explains why attending incoming stimuli decreases prospective estimates and increases retrospective estimates of time. In sum, our model offers a neurocomputational account of prospective and retrospective timing, from low-level neural dynamics to high-level cognition.