Spiking Neural Network Model of Prospective and Retrospective Timing Explains Violation of Scalar Property and Temporal Scaling of Neural Responses

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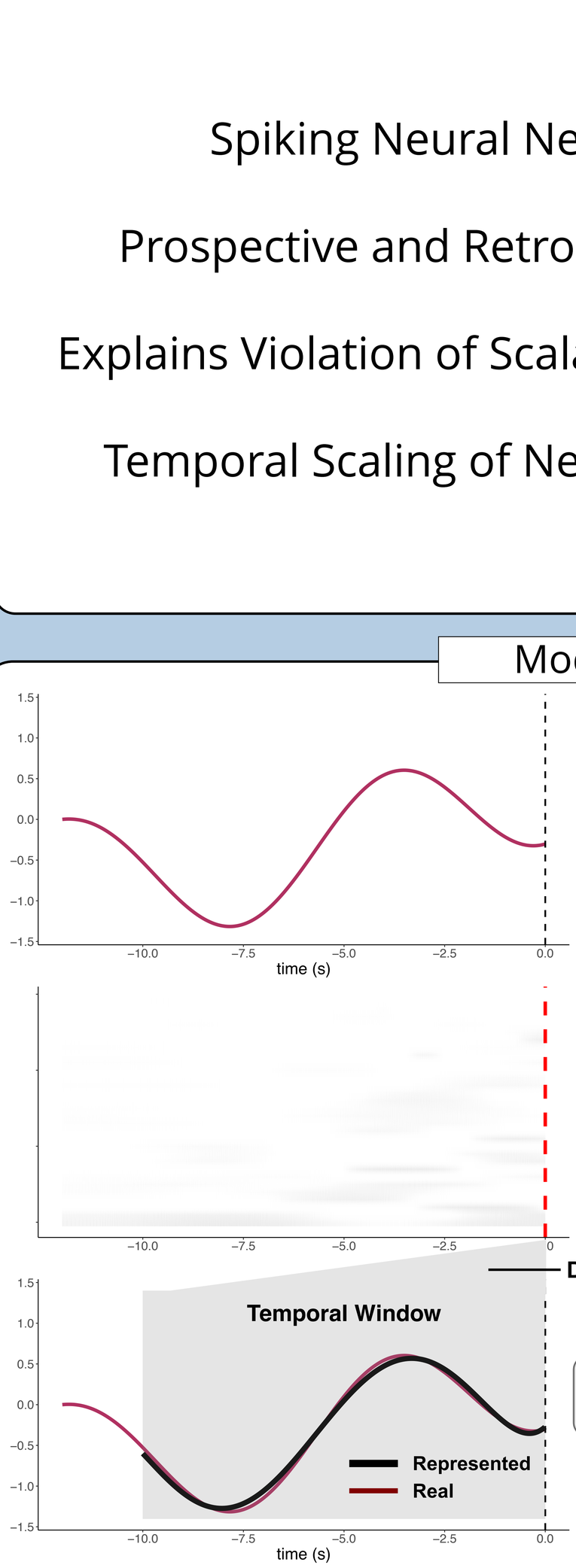
Model

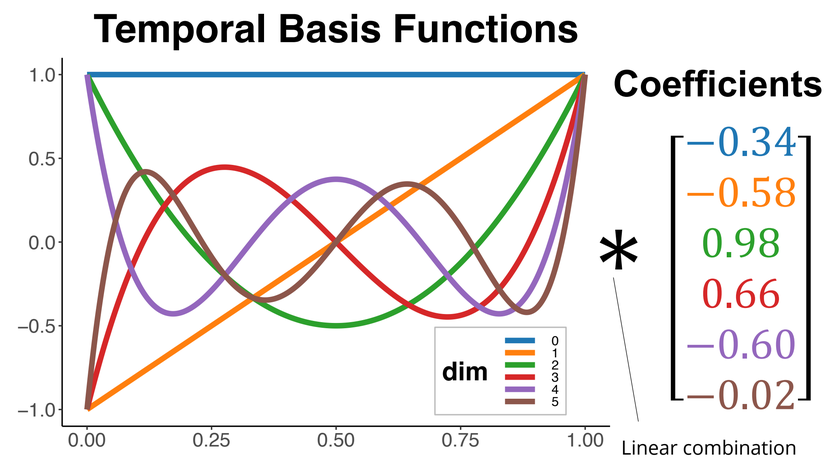


We can flexibly control the size of the temporal window (θ).

In **prospective timing** we approximately know the length of intervals beforehand, so we can match the window size to the target interval, resulting in *optimal timing*.

On the other hand, in **retrospective timing,** we don't know how long the intervals will be, so the window size remains fixed, resulting in *less accurate timing*.

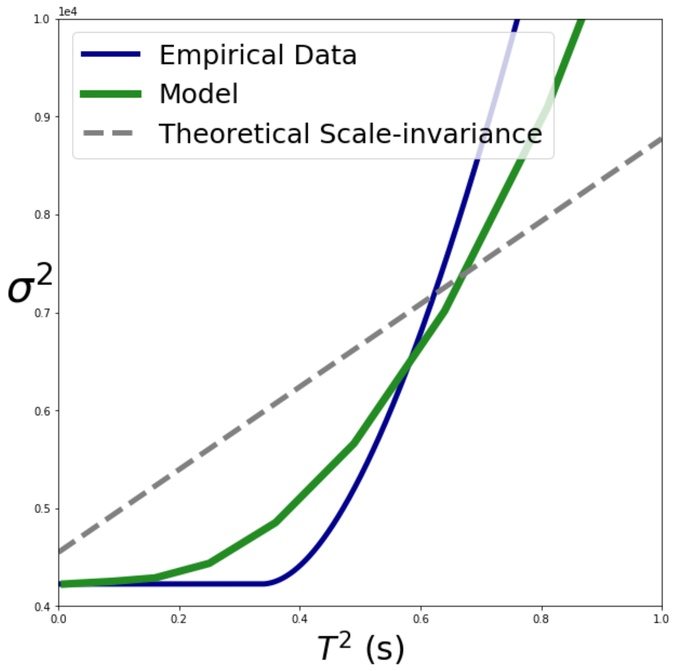
Implementation



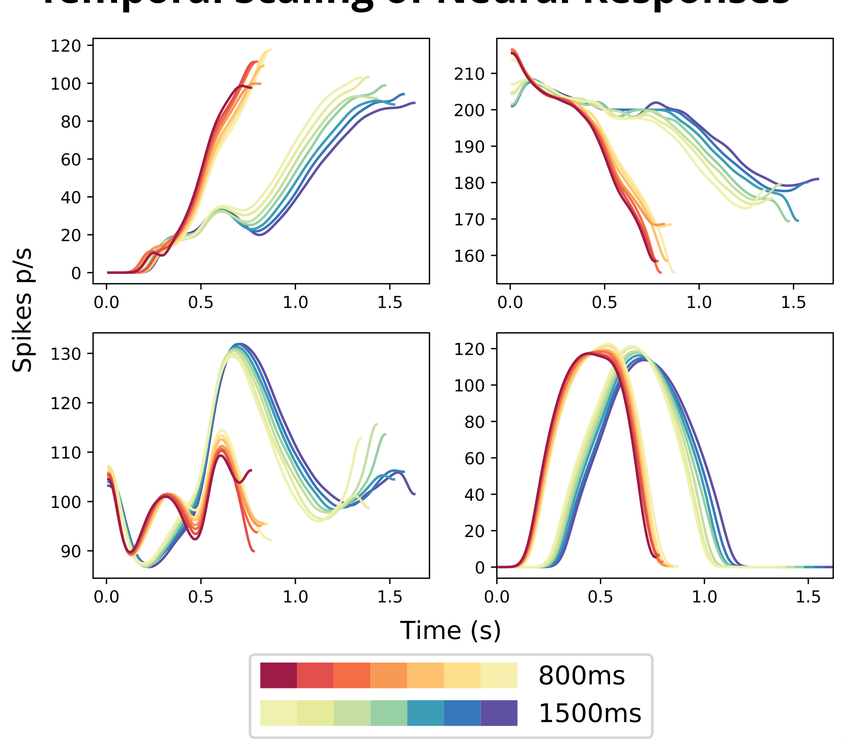
The network[1] computes coefficients on temporal basis functions to represent a temporal window. It is implemented as a Recurrent Spiking Neural Network with the Neural Engineering Framework[2]

Results

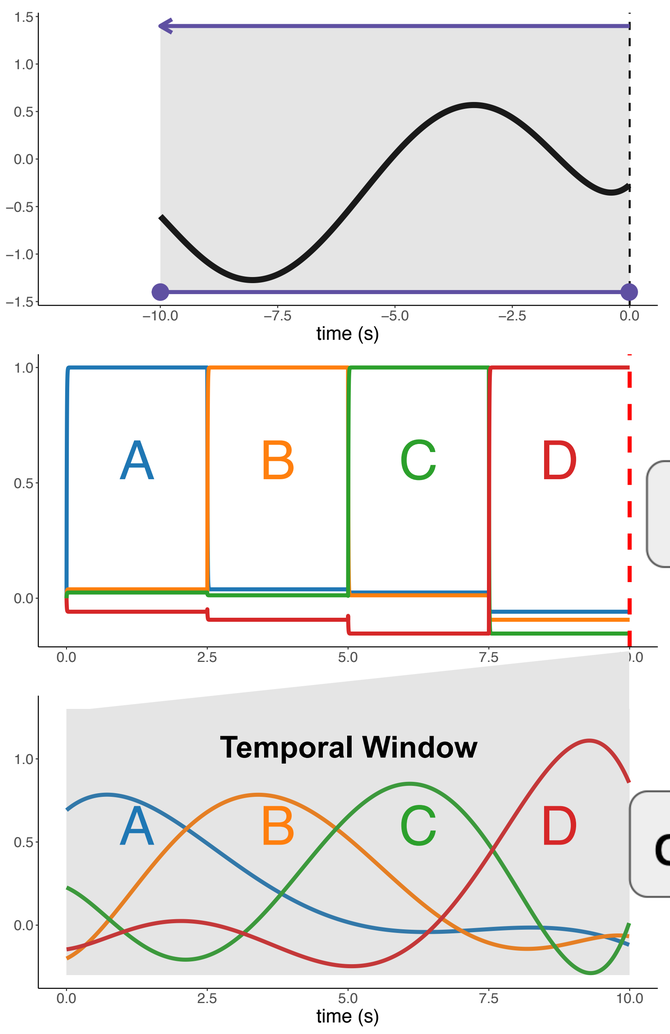
Violation of Scalar Property[3]



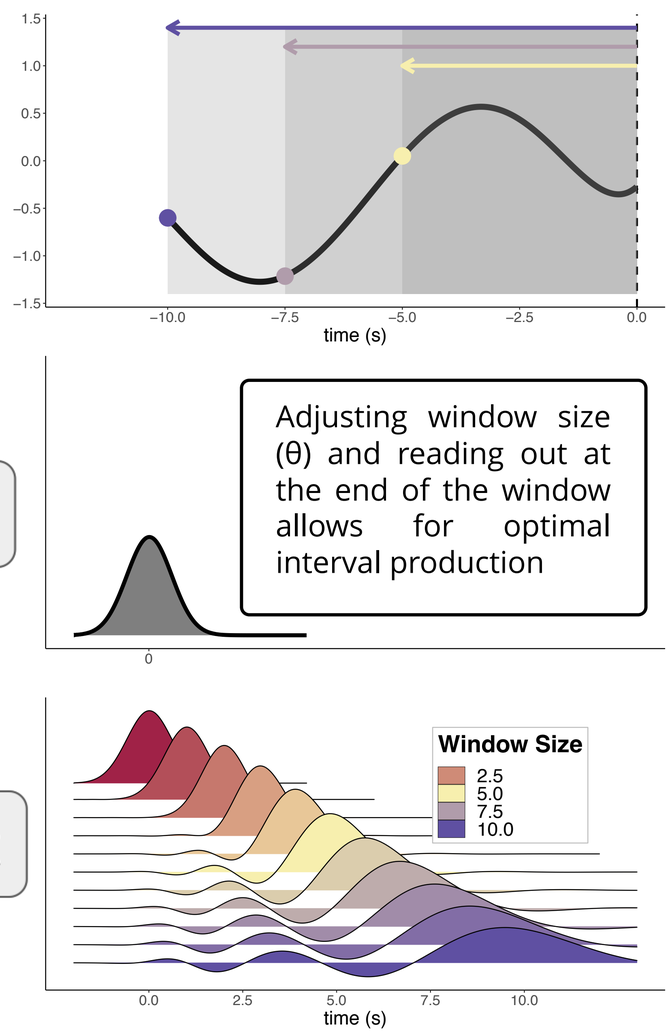
Temporal Scaling of Neural Responses[4]



Retrospective



Prospective



(1). A. R. Voelker, C. Eliasmith, *Neural Computation* (2018).

(2) C. Eliasmith, C. H. Anderson, *Neural engineering: computation, representation, and dynamics in neurobiological systems* (2003)

(3) J. G. Fetterman, P. R. Killeen, *Journal of Experimental Psychology: Animal Behavior Processes*. (1992).

(4) J. Wang, D. Narain, E. A. Hosseini, M. Jazayeri, *Nature Neuroscience* (2018).

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