Abstract Submitted
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Habituation and 1/f Noise BRUCE WEST, US Army Research Office, PAOLO GRIGOLINI, University of North Texas — We present a model to explain the psychophysical phenomena of habituation using methods from non-equilibrium statistical physics and complex network theory. Habituation is a ubiquitous and extremely simple from of learning through which animals, including humans; learn to disregard stimuli that are no longer novel, thereby allowing them to attend to new stimuli.Herein we present a statistical habituation model (SHM) based on a generalization of linear response theory and discrete events using renewal theory. The SHM introduces a theory of the effective synaptic weight connecting two neuron networks, with the synaptic weight being described by a time series with inverse power-law statistics. The statistics determine the distribution of time intervals between events, which in a complex neuronal network leads to neuronal avalanches, see e.g., Beggs and Plenz (J. Neurosci 23, 11167, 2003). The SHM establishes that the fundamental mechanism producing habituation in its myriad of forms is the 1/f-nose that is generically produced in individual neurons and in complex neuronal networks. Both simple harmonic and more complicated stimuli are shown to habituate (decay) as inverse power laws with indices determined by the power-law index of the effective synaptic statistical distribution. This is the first theory that directly relates the psychophysical phenomenon of habituation to the dynamics of the brain.

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