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Predictive information in the retina[1]

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Prediction is important for almost all modes of behavior and our research focuses on how a population of neurons implements predictive computations. We have examined how groups of retinal ganglion cells (RGCs) encode predictive information in their collective firing patterns. Predictive information is defined here as the mutual information between firing patterns across several cells in the retina at a particular time, and the firing patterns of the same neurons at a time Δt in the future. Put simply, we are asking how well the firing of the retina 'now' specifies the firing of the retina in the future. We find substantial predictive information in groups of retinal ganglion cells that grows with the number of neurons pooled. This predictive information is due, in part, to the intrinsic firing properties of the ganglion cells, as well as to correlations in the stimulus. We attempt to disentangle these effects by examining responses to temporally uncorrelated while noise stimuli. We find that roughly half of the predictive information we observe can be accounted for by intrinsic properties of RGCs, while the remaining half is induced by stimulus correlations. To assess what collective properties of ganglion cell firing account for the observed predictive information, we break correlations between cells and within cells in time. We find that the predictive information in groups of ganglion cells outstretches the summed contribution from individual cells' predictive capacities, leading to substantial synergy in larger groups of RGCs. We also assess whether the way in which the retina encodes stimulus information is optimized for prediction. Preliminary evidence suggests that the retina does indeed compress information about past stimuli such that information about the future is maximally preserved.

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