SENSORY ENCODING AND THE EMERGENCE OF MEMORY

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Predictive perception: serial dependence, optimality and neural oscillations

It is well known that perception depends strongly on spatial and temporal context. One clear example of temporal contextual effects is serial dependence, the influence of stimulus history on perceptual judgments in sequential tasks. Serial dependencies likely reflect predictive perceptual processes, where predictions from an internal model based on past experience combine efficiently with current sensory information. We model these effects with an intelligent, adaptable Kálmán filter, which makes clear predictions of how the magnitude of serial dependence should vary for optimal performance. Under a wide range of conditions, and for various attributes (numerosity, orientation, facial gender and expression), the parameter-free optimality-based Kálmán filter model predicted the results qualitatively and quantitatively. Further experiments suggest that the dependence on past experience may be mediated via alpha-frequency neural oscillations, akin to a "perceptual echo". Taken together, the work shows that perception depends strongly on internal models of the world, constantly updated from sensory experience.