

A Theory of Mental Imagery

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Presentation Abstract Summary We present a theory that offers a functional rationale for mental imagery and an explanation for why mental images are experienced as vague and weak. The theory assumes a hierarchical network of recurrently connected brain areas that perform probabilistic inference over retinal input. Analysis of a linear version of the network reveals a putative mental imagery signal that in high-level visual areas is indistinguishable from signals that occur during perception; however, in lower visual areas it differs from its perceptual counterpart by an "echo" transformation that mimics a round-trip routing of perceptual signals through the network hierarchy. In networks with iterative spatial pooling this echo transform should act to reduce the resolution of representations encoded in lower-level areas. We test these hypotheses by constructing imagery receptive field models that link brain activation (human fMRI signals) to imagined stimuli, finding good agreement between theory and results. We conclude that signals underlying mental images exist to help us see, and that the vagueness of mental imagery is a straightforward consequence of spatial pooling in the visual system.

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