

# Dark Control: The Default Mode Network as a Reinforcement Learning Agent

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## Abstract

The default mode network (DMN) is believed to subserve the baseline mental activity in humans. Its highest energy consumption compared to other brain networks and its intimate coupling with conscious awareness are both pointing to an overarching function. Many research streams speak in favor of an evolutionarily adaptive role in envisioning experience to anticipate the future. In the present work, we propose a *process model* that tries to explain *how* the DMN may implement continuous evaluation and prediction of the environment to guide behavior. The main purpose of the DMN, we argue, may be to perform optimization based on Markov Decision Processes through vicarious trial and error. Our formal account of DMN function naturally accommodates as special cases previous interpretations based on (1) predictive coding, (2) semantic associations, and (3) a sentinel role. Moreover, this process model for the neural optimization of complex behavior in the DMN offers parsimonious explanations for recent experimental findings in animals and humans.

**keywords:** systems neuroscience, artificial intelligence, reinforcement learning, mind-wandering