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Predictive neural representations of dynamic sensory input revealed by a novel dynamic extension to RSA

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To successfully navigate our dynamic environment, our brain needs to continuously update its representation of external information. This poses a fundamental problem: how does the brain cope with a stream of dynamic input? It takes time to transmit and process information along the hierarchy of the visual system. Our capacity to interact with dynamic stimuli in a timely manner (e.g., catch a ball) suggests that our brain generates predictions of unfolding dynamics. While contemporary theories assume an internal representation of future external states, current paradigms typically capture a mere snapshot or indirect consequence of prediction, often utilizing simple static stimuli of which the predictability is directly manipulated. The rich dynamics of predictive representations remain largely unexplored. One approach for investigating neural representations is representational similarity analysis (RSA), which typically uses models of static stimulus features at different hierarchical levels of complexity (e.g., color, shape, category, concept) to investigate how these features are represented in the brain. Here we present a novel dynamic extension to RSA that uses temporally variable models to capture neural representations of dynamic stimuli, and demonstrate predictive neural representations of ballet dancing videos presented to subjects in an MEG scanner. This promising new approach can be used with any dynamic stimulus and any dynamic (neural) signal of interest, and it opens the door for addressing important outstanding questions on how and when our brain represents and predicts the dynamics of the world.

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