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Go big and go grounded: Categorical structure emerges spontaneously from the latent structure of sensorimotor experience

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Abstract

Many theories of semantic memory assume that categories spontaneously emerge from commonalities in the way we perceive and interact with the world around us. However, efforts to test this assumption computationally have been hampered by use of abstracted features without clear sensorimotor grounding and over-reliance on small samples of concepts from a limited number of categories. Taking a radically different approach, we examined whether categorical structure emerges spontaneously from the latent structure of sensorimotor experience by creating a fully-grounded multidimensional sensorimotor space at the scale of a full-size human conceptual system (i.e., 11 sensorimotor dimensions x 40,000 concepts). We found evidence for (a) a high-level separation of abstract and concrete categories (which was not enhanced by the inclusion of affective information); (b) a hierarchical structure of concrete concepts that separated categories commonly impaired in double dissociations, such as fruit/vegetables, animals, tools, and musical instruments; and (c) a flatter hierarchy of abstract concepts that separated categories such as negative emotions, units of time, social relationships, and political systems. These findings demonstrate that grounded sensorimotor information is fundamental to the representation of all conceptual knowledge.