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REVIEW

Navigating cognition: Spatial codes for human thinking

Jacob L. S. Bellmund[1,2,3,*], Peter Gärdenfors[4,5], Edvard I. Moser[1], Christian F. Doeller[1,3,*]
+ See all authors and affiliations

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RE: "how a continuous code can be extended to map additional dimensions?"

Arturo Tozzi, Adjunct Assistant Professor,
University of North Texas

(13 November 2018)

In this intriguing paper, the Authors define a concept as "a set of CONVEX (i.e., positive curvature) regions of similar stimuli". Such regions might also display other types of curvatures, such as CONCAVE ones. Indeed, several studies point towards many biological and physical dynamics taking place in negative-curvature phase spaces: this is because trajectories on hyperbolic manifolds allow a more manageable treatment of many of the required equations, such as, e.g., the Fokker-Plank ones. Further, parallel transport from Euclidean spaces to concave manifold allows the assessment of nervous multidimensional dynamics in terms of symmetry breaks, and the latter, i.e., a successful approach borrowed from physics, would be very useful in the description and categorization of higher-dimensional manifolds.
Linked to the issue of the multidimensional brain and nervous symmetries, stands the fundamental question raised by the Authors: "how a continuous code can be extended to map additional dimensions"?

In order to answer, the "evidence of topological representations of spaces in rodents and humans" paves the way to the use of an algebraic topological tool, i.e., the Borsuk-Ulam theorem: provided a function is continuous (in this case, "spatially specific cells provide a continuous code"), a single feature in one dimension (say, a sports car) maps to two features with matching description in a dimension higher (two sports cars, which might be slightly different, e.g., in their emotional, or cognitive content). In other words, when I see a cat in my surrounding 3D environment, I perceive not just the 3D image of the real cat in front of me, but also many multidimensional features of the cat in my mind (emotional: "how tender!", cognitive: "this is a Feline", and so on). Therefore, the use of the Borsuk-Ulam theorem allows us to build symmetric, higher-dimensional topological spaces where mental activity might take place, and to calculate their thermodynamic constraints (given the link between symmetries, informational entropies and topological manifolds).

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Competing Interests: None declared.