DO WE PERCEIVE THE TOPOLOGICAL FEATURES OF VISUAL IMAGES? NO, WE DON'T!

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How do we perceive a visual image? Some authors suggest that we have topological perceptions of visual objects. For example, Singh et al. (2008) were able to cast neural representation in the primary visual cortex in terms of the underlying persistent homology of population activity. Dabaghian et al. (2011) suggested that the hippocampal representation of space in humans and animals can be described in terms of mathematical topological spaces. They concluded that the hippocampus is specialized for computing a topological representation of the environment. Chen et al. (2014) proposed that a topological code rather than a topographic code might underlie hippocampal pyramidal cells' spatial tuning in navigation. In contrast to topographic codes, they favor the efficiency of topological coding, especially in case of sparse sample size and fuzzy space mapping. Dabaghian et al. (2014) demonstrated that during spatial cognition the hippocampal place cells are concerned of the topological qualities (such as connectivity) of an environmental space, rather than its geometric properties (such as distances and angles). Taken together, these authors suggest that, when we explore morphing linear tracks, our brain dissociates the geometry of the track from its topology, the latter being highlighted.
Summarizing, if the above-mentioned authors are right, we would be able to perceive topological findings of visual images, such as, e.g., holes, shapes, connected spaces, disjoint subsets.
Here we show that the human mind does not perceive topological findings of visual images, rather it uses a fully different (and still unknown) mechanism.

A SIMPLE EXPERIMENT

Look at this image of a curtain design: how many spots do you detect?

We showed the image to nine individuals and, although they do not represent a statistically significant sample, all of them answered: fifteen spots. Here you are the spots located by them:

However, by a topological standpoint, the shapes located in the lower part of the picture are connected, since they belong to a single shape:

This means that the number of spots detected by our brain during visual perception does not correspond to the topological number of shapes. Indeed, if our perception would work according to topological rules, we could count a different number of spots:

CONCLUSIONS

Several Authors, including ourselves, have suggested that rules from algebraic and network topology underlie the neural and neuronal mechanisms giving rise to the functions and mental activities of the human brain (Tozzi and Peters 2017; Babichev et al., 2019). However, our simple, rather naive experimental observation suggests that topology plays no role, at least when coping with the macroscopic level of the ultimate steps of visual perception.

This implies, once again, that our brain builds internal representations of the external world, independent of the mathematical features subtending visual images.

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