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A 'compass' in the brain to navigate thoughts

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A new discovery by the University of Trento on the analogies between moving in the physical and conceptual space: the brain has cells that act as a navigation system, but also has cells that function as a sort of compass. Scholars of CIMeC at UniTrento have discovered that the same neural mechanisms that signal the direction of movement in the physical environment are also used for orientation and navigation in abstract spaces.

The results of their work were published today in the journal *Communications Biology*. The authors of the study are Simone Viganò, Valerio Rubino, Marco Buiatti and Manuela Piazza, who is also the head of the research team at the Center for Mind/Brain Sciences-CIMeC of the University of Trento.

Some time ago, the research team provided experimental evidence that the populations of neurons that provide spatial information based on a grid-like system (as a navigation system) are activated not only to navigate the physical environment, but also to navigate in the abstract space of ideas and concepts. These neuronal populations are called place cells and grid cells, and are located in the hippocampus region and in the medial prefrontal cortex.

Now, the same research team—again using magnetic resonance imaging—has demonstrated that another type of brain cells is involved in abstract thinking, which is complementary to the previously identified types, and which acts as a sort of compass for orientation in the space of ideas. In this study, the research team searched for the involvement of so-called head-direction cells, which have been identified in the brains of several species of non-human animals when navigating physical space.

"Using magnetic resonance imaging, we have shown that there are populations of neurons, mostly located in the medial parietal cortex, that behave like head-direction cells; in other words, they signal the direction of movement even when movement does not occur in a physical space, but in an abstract, conceptual space. This discovery suggests the existence of a complementary mechanism for conceptual navigation outside the hippocampal formation," the research team concluded.

More information: Simone Viganò et al, The neural representation of absolute direction during mental navigation in conceptual spaces, *Communications Biology* (2021). DOI: 10.1038/s42003-021-02806-7

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