A GPS of the brain that organizes concepts

A research group of CIMeC of the University of Trento found out that the same brain areas and coding schemes are activated when navigating through geographical and conceptual spaces. The study, which for the first time indicates that the same spatial maps are used for places and ideas, appeared in the “Journal of Neuroscience”.

Trento, 26 February 2020 – (e.b.) Navigating the streets of a city, the rooms of a house, or abstract spaces. There is no difference for the human brain: the task requires the same brain areas and coding schemes. As if the brain used the same skills for navigating a physical space and for moving around ideas.

This was theorized by many scientists, including Nobel prize laureate Edvard I. Moser, but a team of researchers of CIMeC, the Center for Mind/Brain Sciences of the University of Trento, was able to prove it with the similarities in the working of the brain when navigating physical and abstract spaces. The discovery also explains why memorization techniques like the method of loci and conceptual maps are so effective to learn names, dates and events and strengthen memory skills. The similarities between navigating in our environment and in our ideas also provide new insight to investigate the physical (motion and orientation) and cognitive (memory loss) impairments that affect people with Alzheimer's disease, which are caused by the neuronal deterioration in the brain areas responsible for those functions.

"We have verified this theory for the first time", underlined Manuela Piazza and Simone Viganò, respectively professor and postdoc researcher at the Center for Mind/Brain Sciences of the University of Trento, who are the authors of the article that was recently published in “Journal of Neuroscience”.

The research work was carried out at the functional neuroimaging laboratories of the Center for Mind/Brain Sciences of the University of Trento. The participants in the study were presented with a number of objects or words they had never seen before and they were asked to learn and categorize them. The objects were different in terms of size and sound frequency, therefore creating a bidimensional semantic environment.

The researchers then showed the participants the various objects and words in random order during a functional MRI session to see their neural activity, and found that the neural areas involved in spatial navigation are also involved in thinking and reasoning. These neural areas, in particular, are responsible for identifying the information required (direction and distance) to map the brain reasoning from one idea to the next.

"These results – the authors added – demonstrate that the human brain recycles the same coding schemes it has developed in its long evolutionary history to navigate the physical environment to organize memories in a conceptual space and literally navigate in an environment made up of ideas. They also explain why learning techniques that have been
known since ancient times, like the method of loci and conceptual maps, are so effective to learn things and to easily remember them.

"To effectively move around an environment – they continued – we must remember where things are, how distant they are from each other, which direction we must take to reach them". This ability is based on the functioning of a number of brain cells (neurons, which are located in the hippocampal region and in the medial prefrontal cortex) that are turned on when we are in a given position or when we take a given direction, like a brain GPS. This very GPS also helps us organizing complex memories and ideas".

**About the article**

The article "Distance and direction codes underlie navigation of a novel semantic space" was published in "Journal of Neuroscience" on 14 February 2020. Its authors are Simone Viganò (postdoc researcher) and Manuela Piazza (associate professor) of the Center for Mind/Brain Sciences of the University of Trento.

The paper is available here: [https://doi.org/10.1523/JNEUROSCI.1849-19.2020](https://doi.org/10.1523/JNEUROSCI.1849-19.2020)

For more information:

**Press Office**

Directorate of Communication and External Relations
Università degli Studi di Trento
tel. +39 0461 281131 – 281136
ufficio.stampa@unitn.it
Past press releases: https://pressroom.unitn.it/tag/english