Raw or cooked: This is how we recognise food

May 30 2019

Thanks to a particular organisation of our memory, two different regions of the brain are involved in identifying natural food with respect to processed foods: to say so is new research published in *Scientific Reports*. Credit: Rachel Park on Unsplash

Do we see a pear or an apple? The occipital cortex in our brain will

activate itself to recognise it. A piece of bread or a nice plate of pasta with sauce? Another region will come into play, called the middle temporal gyrus. Different regions are implicated in recognition of different foods, raw in one case and processed in the other, because two components of the so-called "semantic memory," the one that we always use to recognise the world around us, are involved. More specifically, according to new research by SISSA just published in *Scientific Reports*, to identify "natural" foods, such as fresh fruit, the "sensory" component of semantic memory is required, in which sensory information, like visual or tactile input, allow us to identify an object. On the other hand, for processed or cooked foods, other areas are preferentially engaged: areas associated with semantic memory that are involved in the recognition of functional features, with which we succeed in identifying an object through the function we associate to it. The results of this study have opened up new prospects for investigation of how our memory functions and of how our brain processes information related to food.

The importance of identifying food processing

"Food is essential for life. It is therefore of paramount importance that its key characteristics (is it poisonous? is it tasty? is it nutritious?) are readily recognised. To come to our aid, in this case, is our semantic memory, which is a large personal store of information on everything that we know, including the sensorial or abstract properties of the objects. Semantic memory allows us to give a name and a meaning to what we have encountered during our existence," explain Miriam Vignando and Raffaella Rumiati, lead author and research director, respectively : "Speaking of food, one of the key characteristics to identify is certainly the level of processing it has undergone."

Natural and processed food, living and non-living

"We hypothesised that the recognition of raw food is based on the properties that involve our senses: sight, taste, touch. Instead, we proposed processed food recognition to be based on its functional properties: the process it has undergone, the nourishment it is able to provide, the moment in which we have to eat it, for example. This division reflects the model of sensorial-functional memory proposed several years ago, to explain how semantic memory works. According to this approach, there is a part of semantic memory, the sensory part, responsible for identifying 'living things,' and a functional part, responsible for identifying 'non-living things.' We wanted to understand if this approach could also be applied to identifying food," say the two scientists.

An experiment carried out with recognition tests

"To answer our question, in the study we enrolled healthy participants, and patients affected by different neurodegenerative diseases characterised by extensive damage to the parts of the brain associated with semantic memory." All the individuals were administered recognition tests: they were presented with images of food, natural and processed, but also images of non-edible items, divided between living things (for example, plants) and non-living things (for example, utensils). To explore the relationship between the integrity of semantic memory for the categories of interest and the cerebral volume, a "morphometric" technique was used called voxel-based morphometry (VBM). This technique allows correlation of the score of a test, in this case of semantic tests, with the volume of the brain, shedding light on the regions that correspond to low scores if atrophied.

Identification of the cerebral regions connected with food recognition

The results confirm that the same cerebral region is involved in recognition of natural foods and living things—the occipital lateral cortex—the part of the brain involved in sensory semantic memory. Another part of the brain, the middle temporal gyrus, involved in functional semantic memory, is involved in recognising both processed foods and non-living things. "Our hypothesis is therefore confirmed," say Vignando and Rumiati. "But there is more: this research has allowed us to identify various cerebral regions that are strongly related to food recognition, as if there was a network of regions responsible for the retrieval and integration of information regarding food, making it possible for us to correctly interact with it. To eat it or cook it, for example. Therefore, this process would be the result of the joint action of different parts of the brain, some aimed at recognising its sensory and functional properties, others at integrating and coordinating behaviour on the basis thereof."

The clinical implications of the study

This is particularly interesting if we think about possible connections with more clinical implications: indeed, one of the most frequent symptoms of several neurodegenerative diseases is eating disorders. This study paves the way for an investigation of the role that semantic memory plays in this behaviours.

More information: Miriam Vignando et al, Food knowledge depends upon the integrity of both sensory and functional properties: a VBM, TBSS and DTI tractography study, *Scientific Reports* (2019). DOI: 10.1038/s41598-019-43919-8

Provided by International School of Advanced Studies (SISSA)