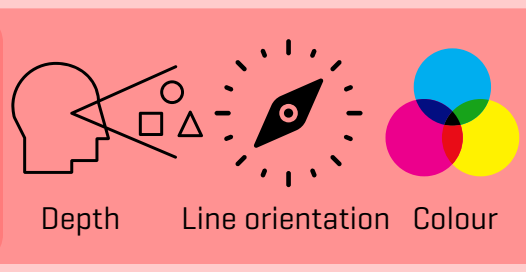
How our brain creates coherent images

Research by Pieter Roelfsema

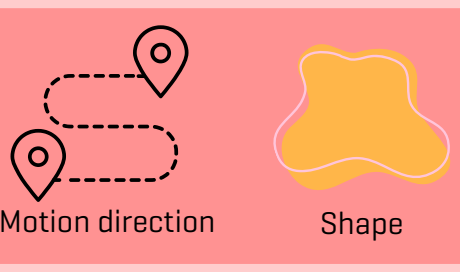
When we look at something, the different properties of the image are processed in different brain regions.
But how does our brain make a coherent image out of such a fragmented representation?

The processing of images

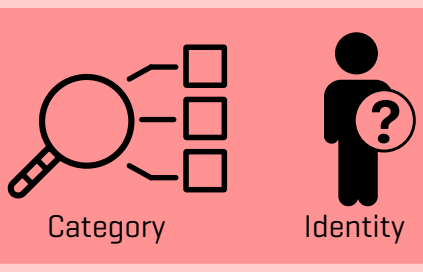
1. Neurons in low level brain regions extract basic features such as line orientation, depth and the colour of local image elements.



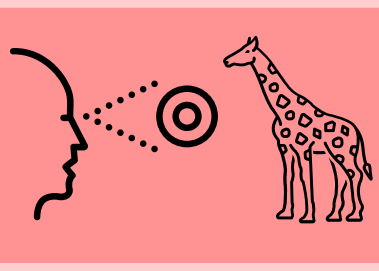
2. They send the information to higher level brain areas. Neurons in these areas code for other features, such as motion direction, color and shape fragments.



3. Next, the information is sent to yet higher levels for an even more abstract analysis of the visual scene. Neurons at these higher levels code for the category of objects and even for the identity of specific individuals.



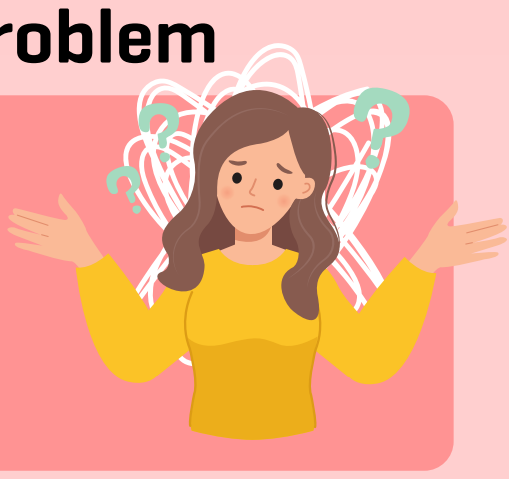
4. Eventually, an image can be recognised.

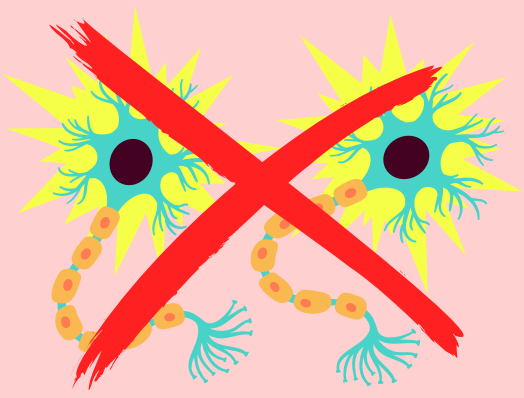


Multiple objects? The binding problem

When there are multiple objects in a field of vision, the question is how the brain is able to recognise which features belong to one of the objects and which ones belong to the others.

This is called the binding problem.





At first, scientists believed that objects could be separated thanks to "synchronisation" of neurons. The neurons that respond to the same object would synchronise their activity by firing with a similar rhythm.

We now know that this is in fact not the case.

So how does it work?

Neurons do not synchronise, but their activity increases. It is possible to observe several objects at the same time, but determining which properties belong to one of the objects requires attention.

'The binding problem is therefore not solved by synchronization, but by an increased firing rate of neurons. Many scientists still believe in the synchronization theory, even though this is incorrect. Pieter Roelfsema's new review lists the evidence for and against the two binding theories.'

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Link to the article: How does our brain create a coherent image when we look at different objects?