Perception:

how our brain builds a picture of the world around us

By Dr Maxine Sherman
Research Fellow in Cognitive Neuroscience,
University of Sussex

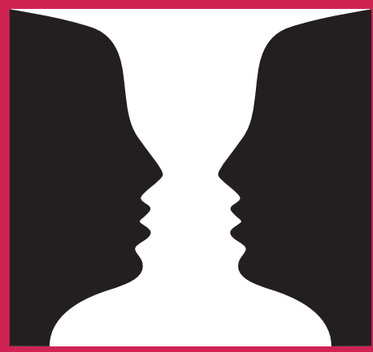
The brain processes sensory signals to build a picture of our environment

Signals that enter through our eyes are just electrical signals without colour and depth

It's easy to rely on our senses and imagine that they are perfectly accurate. We often rely on our vision – but signals that enter through our eyes are just electrical signals. These signals are noisy, without colour and without depth. When our brain first receives a signal from the eyes the image is actually upside down, and our brain needs to 'flip' it for us before building an accurate picture of the world. And what about our hearing or sense of touch? Can we trust the way our brain interprets the world?

How does our brain 'decide' what to see?

The majority of cognitive psychologists and neuroscientists think of perception as a kind of decision-making process implemented by the brain. The idea is that the brain decides between several or many possible environmental states that cause the sensory signals detected by our sensory organs. Sometimes these causes can be rather ambiguous, as shown in Rubin's face-vase illusion below. Depending on how we interpret the image we could perceive two people facing each other or a white vase against a black background. These two 'percepts' are like two competing possibilities that the brain must choose between: did our eyes receive signals from two faces or from a vase?

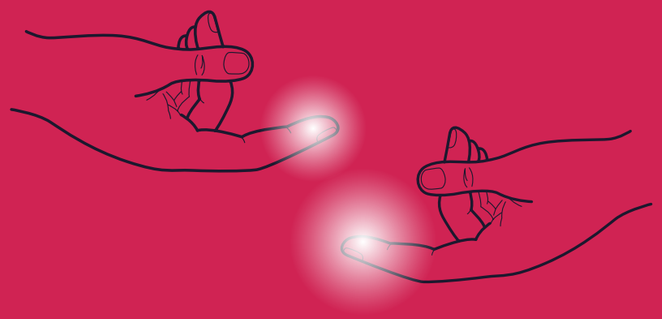


Beyond our conscious perception

Imagine that you are at a loud party, and it is so noisy that you cannot hear what others are saying. If somebody says your name it is likely to capture your attention and lead you to pick up on it, despite being unable to hear the rest of the conversation. This phenomenon is one manifestation of the so-called 'cocktail party' effect. It raises an important issue: for your name to have captured your attention you must have heard it being spoken, because strangers' names do not capture your attention. But how did this happen if you cannot hear what people are saying?

Effects such as these are taken as evidence of unconscious perception. Unconscious perception refers to the detection of external stimuli by the brain that go on to influence our behaviour (in this example, our attention), yet which remain outside of our awareness. Their detection means that they have been perceived, but the absence of us knowing or feeling their detection means they are unconscious. A key question in psychology and neuroscience is why are we aware of some stimuli but not others? Which features or processes warrant access to awareness?

Back in 1884, two scientists, Pierce and Jastrow, designed an experiment to test unconscious perception. They applied pressure to participants' fingers and then increased or decreased it very slightly. They asked participants to describe if they were feeling more or less pressure, and how confident they were in their answers. The research showed that participants were able to sense the changes in pressure, but they had no confidence in their judgements. The experiment appears to suggest that we can sometimes perceive things we are not conscious of.



Research suggests that we are more likely to be aware of something that:

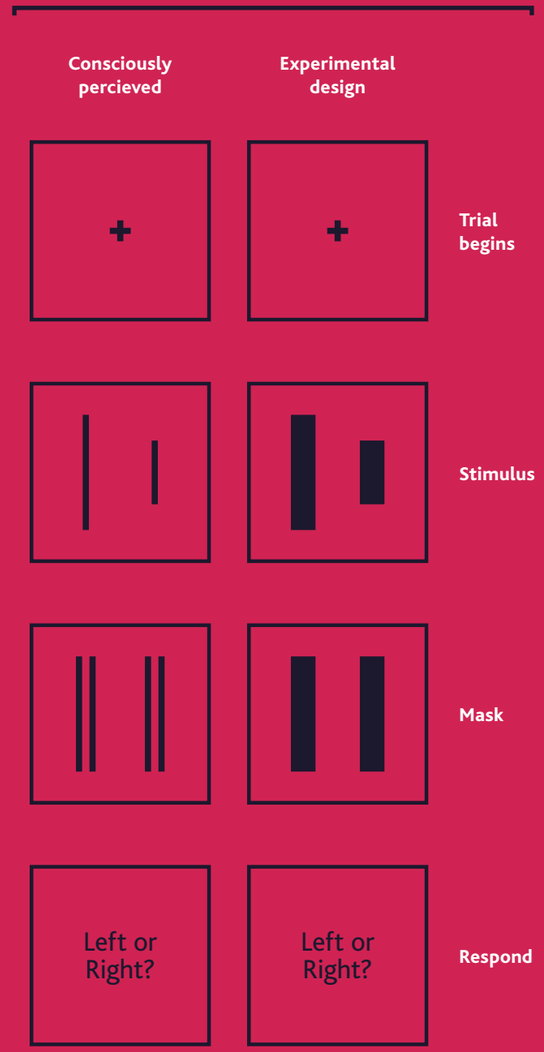
- we're focusing on
- we are expecting
- stands out
- we are holding in our working memory

However, we can still miss things under these circumstances, and be aware of things even without these factors.

Testing our consciousness

Unconscious perception is often investigated with a technique called 'masking' – in these experiments participants will sit at a computer and will be briefly presented with a stimulus. The stimulus is then quickly covered with a 'mask' that renders the stimulus invisible, and the participants will be asked to make a judgement about the stimulus.

In 1974 Tony Marcel used masked words to test unconscious perception. A word such as 'salt' would be shown to participants, then swiftly 'masked'. Next, participants would be asked to choose between two words, for example 'pepper' (which is linked to 'salt') and 'lotus' (which is unrelated to 'salt'). Participants were more likely to choose the related word, indicating that even though they could not consciously 'see' the first word, it nonetheless influenced their choice.



The study of perception investigates how our brain builds a 'picture' of the outside world.

What brain disorders can tell us

Another way to explore consciousness is to study the behaviour of patients with brain damage in regions linked to visual consciousness to see if visual consciousness is impaired.


Striate cortex

One such condition is 'blindsight' – individuals with this condition have damage to a part of the brain called the striate cortex, which is dedicated to early visual processing. Although their eyes are healthy, these patients are unable to consciously see. However, tests seem to indicate that their unconscious vision is somewhat preserved.

In one experiment, a test subject, referred to as 'TN', was asked to navigate a hallway. TN did not know that experimenters had placed obstacles in his way, but remarkably he still moved around them. Research such as this shows that people with blindsight can still perceive things unconsciously.

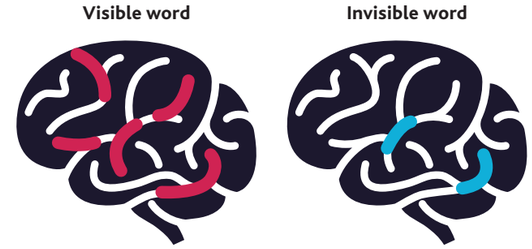
Looking at perception in the brain

So what can we do without awareness? And what happens in the brain when objects are only unconsciously perceived? Finding the answers to these questions would tell us more about what consciousness is 'for' and about the parts of the brain are involved in building our conscious experience.

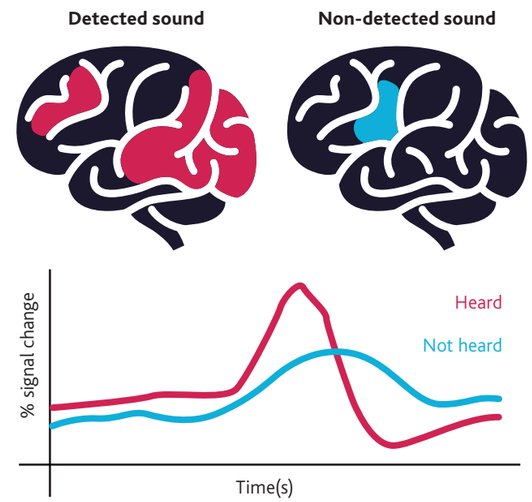
A great deal of evidence, for example from masking studies or patients with blindsight, suggests that we can perceive quite a lot without awareness. Researchers have found that certain regions in the brain are involved during conscious and unconscious perception. The parts of the brain that react unconsciously to stimuli match the parts of the brain usually used to process that type of information (for example, visual areas for vision; auditory areas for sounds; language areas for words).

However, a broader set of regions is involved when a stimulus is consciously perceived than when it is unconsciously perceived. When a sound is consciously heard we see activation of auditory, language and prefrontal-parietal regions; when the sound is not consciously heard, only auditory and language regions are activated.

Language



Auditory



Perception is still a bit of a mystery

The study of perception investigates how our brain builds a 'picture' of the outside world; one that is useful to guide our behaviour. Scientists who study perception are really looking to find out how the brain processes and selects sensory signals to build a coherent and largely accurate picture of our environment – but many of the details remain unknown and there is still much research to be done.