Do we all have synaesthesia?

Everyone is potentially born with synaesthesia, where colours, sounds and ideas can mix, but as we age our brains become specialised to deal with different stimuli.

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While rare in adulthood, scientists think that about 4.4 % of the population has some type of fully fledged synaesthesia, with one of the most common types being grapheme-colour synaesthesia. Such synaesthetes have a one-to-one association linking letters and numbers with a certain colour.

Scientists are fairly confident that synaesthesia is inherited, but most research about synaesthesia has been on adults, and researchers don't know much about how it behaves in early life or in old age.

However, they have noticed that the number of synaesthetes goes down with age, and a team of researchers headed up by Dr Julia Simner at the University of Sussex in the UK is preparing to run large-scale tests in primary schools as part of a research project called MULTISENSE.

'Our goal is to examine this in young children and to sort of try and map out how synaesthesia develops and how common it is,' project researcher Duncan Carmichael explained.

The project, funded by the EU's European Research Council, is creating an online battery of tests for synaesthesia in children to identify conditions such as grapheme-colour synaesthesia.

‘You’d have a simplified colour palette and you’d present them in a random order and you’d ask what colour should we paint “K”, for instance,’ Carmichael said. People with synaesthesia will give the same response again and again, even if they are asked months later.

They hope to have the first tests ready towards the end of this year, which will allow them to benchmark them through a pilot study of a small group before they begin testing around 4 000-5 000 primary school students from the age of five and up.

Synaesthesia emerges around the age of four or five and it is more common in younger children. By age 10, the amount of synaesthetes will have already decreased.

‘Everybody potentially starts off as a synaesthete,’ Carmichael said. ‘As the brain develops or responds to the input it receives, we lose this kind of connectivity and we lose these superfluous connections between neurons, and different areas of our brains become specialised to respond to different stimuli.’

The researchers also hope to develop some information for educators on how to recognise and offer help to synaesthetes, whose clashing colours can make doing things like elementary maths difficult. In a class of 25 students, scientists expect there would be at least one child with synaesthetic traits.

It may even be that we all have a bit of synaesthesia within us, and that synaesthetes are just on the upper end of a scale of merged senses.

‘If you ask people to match colours with sounds, for example, most people will match light colours with higher pitched sounds. That seems a very common sense, intuitive kind of response, but there is no real reason why it should be like that,’ Carmichael said.

The reason for such background associations may lie within the structure of the brain.

When we look at an object, we immediately make lots of associations. Neurons that are specialised in detecting one thing, say edges, fire off impulses. It’s then up to the brain to make sense of everything and suppress what is not relevant in our unconscious mind. But for synaesthetes, normally superfluous information may make it to the top of the pile, producing unusual sensory associations.

Rooted in the brain

And in fact a separate group of researchers has discovered just how deeply the way we handle multisensory information is rooted in the brain.

At the Charité-Universitätsmedizin Berlin, Germany, neuroscientists at the MULTISENSORY-MIND project, funded by the ERC, were looking into how the brain processes information from multiple senses, and whether it was different for schizophrenic patients.

You may have heard the term brain wave – different frequencies of electrical impulses that are generated by neurons and which are linked to different levels of brain activity. Such electrical oscillations are taking place all the time in different parts of the brain as neurons process information.

The team in Berlin wanted to examine how such waves link up or synchronise when the brain tackles multisensory information.

Researchers study subjects’ brain waves while they use multiple senses like sight and touch to see how the brain pr
Researchers study subjects’ brain waves while they use multiple senses like sight and touch to see how the brain processes stimuli. Images courtesy of MULTISENSORY-MIND

‘It’s like in a soccer stadium where you have a fan club and they’re singing one chorus and then the opposite side starts singing and they are somehow interacting with each other,’ the principal investigator, Dr Daniel Senkowski, explained.

They were especially interested in gamma waves, oscillations with a frequency around 40 Hertz that were known to be related to one of the brain's most important inhibitory neurotransmitters, called gamma amino-butyric acid (GABA). GABA is a chemical messenger that modulates the acitivity of neurons.

Dr Senkowski and his team wanted to measure whether that neurochemical system was also involved in moderating how the brain handles multisensory data.

Schizophrenic people are known to have problems processing information, and they thought that lower rates of chemicals like GABA might also give them problems with multisensory processing.

To test their hunch, Dr Senkowski and his team used electroencephalography (EEG) to measure precisely what happened in the brain when subjects were exposed to multisensory stimuli like touch and video. They also used magnetic resonance spectroscopy that let them measure specific amounts of chemicals like GABA in different parts of the brain, specifically the temporal lobe.

Investigating healthy individuals, Dr Senkowski and his team found that the GABA concentration in the temporal lobe was related to gamma waves during multisensory processing. But the data they got back from schizophrenic patients surprised them. Where they had assumed that there would be a lower level of GABA, and therefore the ability to deal with multisensory information, they actually found levels similar to healthy patients.

The next step is to see if there is a direct relationship betwen the brain oscillations and changes to the way people perceive multisensory information.

'One thing our field should do now is to manipulate oscillations in the brain, and you can do this with specific non-invasive methods like transcranial magnetic stimulation, where … you induce an oscillation, and you can investigate if this changes the way we integrate multisensory information,' Dr Senkowski said.

If you have colours for letters or numbers, and you are interested in taking part in the genetic test for synaesthesia being run by Dr Julia Simner at the University of Sussex, please email the Sussex synaesthesia lab at synaesthesia.research@ed.ac.uk

More info

MULTISENSE

MULTISENSORY-MIND