Genetics and environment combine to give everyone a unique sense of smell

April 25 2017

Credit: martha sexton/public domain

Researchers from the Wellcome Trust Sanger Institute and their collaborators have shown that receptors in the noses of mice exposed to

certain smells during life are different to genetically similar mice that lived without those smells. Published today in *eLife*, the study found it is this combination of genetics and experience that gives each individual a unique sense of smell.

Our sense of smell comes from the olfactory organ in the nose, which is made up of sensory neurons containing receptors that can detect odours. There are about one thousand types of olfactory receptors in the nose, compared with only three types of visual receptors in the eye, and 49 types of taste receptors on the tongue. Of our senses, the olfactory system is the most complex, and combinations of signals from different olfactory receptors allow people to smell an enormously large repertoire of odours. However, how different people vary in their smelling abilities is not well understood.

To investigate the sense of smell the researchers used laboratory mice as a model, comparing the olfactory neurons from genetically identical animals that grew up in different environments. They also compared animals that grew up in the same environment but were genetically different.

The team used RNA sequencing to see which receptor genes were active. The researchers found that genetics controlled which receptors were present in the mice. Crucially however, they found that the environment that the individual had lived in had a significant effect on the number of cells able to identify each smell.

Professor Fabio Papes, an author on the paper from the University of Campinas in Brazil, said: "It became clear that the role of genes, especially those that encode olfactory receptors in the genome, is very important in the construction of nasal tissue, but there was a very remarkable contribution of the environment, something that has not been previously described to this extent. We found the cellular and molecular

construction of the olfactory tissue at a given moment is prepared not only by the organism's genes but also by its life history."

Olfactory neurons are formed throughout an individual's lifetime, and the study showed the olfactory system adapted to the environment, leading to more cells capable of detecting scents to which there has been greater exposure. As a consequence, different individuals, even if genetically similar, may have completely different olfactory abilities. This could contribute to the individuality of the sense of smell, even in humans.

The knowledge that an individual's history can affect the structure of olfactory tissue neurons may have implications for personalised medicine as different people's sense organs could be constructed differently and respond in different ways. Studying olfactory neurons can also provide information about how the neurons in the brain are organised and function.

Dr Darren Logan, the lead author on the study from the Wellcome Trust Sanger Institute, said: "The neurons in the olfactory system are highly connected to the neurons in the brain and studying these can help us understand neuronal development. We have shown that each individual has a very different combination of possible olfactory neurons, driven by genetics. In this study we also show that, with experience of different smells, these combinations of neurons change, so both genetics and environment interplay to give every individual a unique sense of smell."

More information: Ximena Ibarra-Soria et al, Variation in olfactory neuron repertoires is genetically controlled and environmentally modulated, *eLife* (2017). DOI: 10.7554/eLife.21476

Provided by Wellcome Trust Sanger Institute