What does it *feel* like?

The FEEL project are developing a new approach to the 'hard' problem of consciousness, pursuing theoretical and empirical research based on sensorimotor theory. We spoke to the project's Principal Investigator **J. Kevin O'Regan** about their work in developing a fully-fledged theory of 'feel', and about the wider impact of their research

The 'hard' problem of consciousness, of explaining how certain types of brain activity give rise to certain types of 'feels', such as the way we experience colour and taste, is a major area of research in both philosophy and neuroscience. Based at the Laboratory of Perception Psychology at the University of Paris Descartes, J. Kevin O'Regan is the Principal Investigator of the FEEL project, in which researchers are developing an alternative way of thinking about consciousness. "The idea is that the way most people currently think about consciousness is a mistake. Most people think consciousness is something that the brain generates – just like the vitalists at the beginning of the twentieth century thought that life was something that biological systems generated," he says. "We now know that this was the wrong way of thinking about life, because there is no vital spirit. In fact, life is just a word that describes the potentialities of certain systems interacting with the world. I think that consciousness is similar to life, in that there is nothing generated by our brains that corresponds to consciousness."

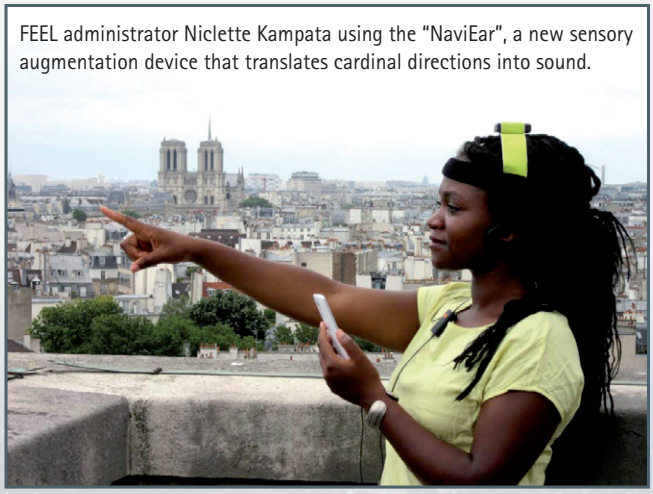
Sensorimotor theory

The project is instead building its research on the sensorimotor theory developed by O'Regan, which suggests that consciousness and 'feel' are ways of interacting with the environment. Just like the feel of the softness of a sponge is constituted by the fact that it squishes when you press it, all sensory feels are constituted by the sensorimotor laws that govern how you interact with things in the world. Certain predictions can be made using this approach, one of which is the possibility of sensory substitution. "Sensory substitution is a method by which you can replace one sense by another. For example, you might be able to use your skin to get input which provides you with visual sensations -- something Paul Bach y Rita had already tried to do back in the 1970's. Or you might be able to use your ears to get input that gives you tactile sensations," explains O'Regan. This raises the question of what it is about a specific neural activity that gives it a visual, tactile or auditory feel; O'Regan says the answer lies in the sensorimotor laws that describe it. "There's nothing special about the optic or auditory nerves that gives the nerve impulses they carry a visual or auditory character. What gives visual information its visual character is what I call the sensorimotor contingencies, that is, the laws that govern how you interact with the world when you see" he says.

A first key part of the project is to build the mathematical basis behind the concept of sensorimotor contingencies. This theoretical work, being developed by Alexander Terekhov and Guglielmo Montone in O'Regan's team, should then prove relevant to the development of sensory substitution devices. "But instead of substituting one sense for another," says O'Regan, "one thing we're doing with Frank Schuman and Christoph Witzel is to actually create a new sense. This new sense is a sense of space. We know that some birds navigate by using the earth's magnetic field – they have little grains of ferrite in their brains, and sensors that sense the orientation or movement of these grains. Wouldn't it be nice if humans could also have such a magnetic sense? If we can provide the brain with extra sensations like this, then maybe we can not only compensate for disabilities, but expand or enhance human capabilities."

Colour perception

A number of other predictions can be made on the basis of sensorimotor theory, including the existence of change blindness, a phenomenon where an observer fails to notice a change in a visual stimulus. One workpackage within the project is dedicated to investigating colour. "Why does red seem



FEEL administrator Niclette Kampata using the "NaviEar", a new sensory augmentation device that translates cardinal directions into sound.

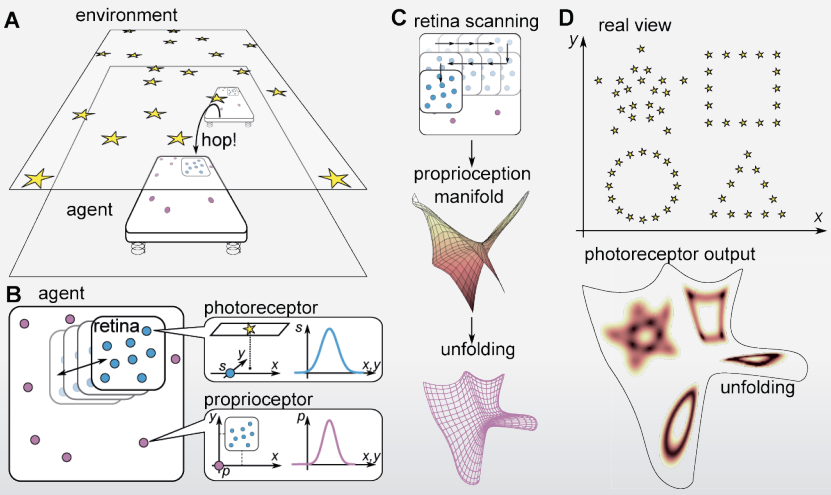
Image Above: The same picture of the dress cut out and pasted into the shadow (left) where it appears gold and white; and into the sun (right) where it appears black and blue. To see the differences in colour perception between the two images more clearly, cover one of the two images when looking at the other. Ideally it is best not to have previously seen any photo of the dress - (Copyright © Witzel, Racey & O'Regan in press).

red to us rather than seeming green? Could it be that when you look at a red patch of colour, the feel that you get is the same feel as I get when I look at a green patch of colour?" asks O'Regan. Again, researchers can use sensorimotor theory to gain a deeper understanding of this question. "Sensorimotor theory predicts that the 'redness of red' depends on the way red things behave when they're acted upon," continues O'Regan. "So if you take a red piece of paper, and move it around under different lights, then the light coming into your eye changes. The reflection from the red piece of paper changes, because it's facing other kinds of light. Sensorimotor theory says that, analogously to the feel of softness of the sponge, the feel of red is constituted by the law that describes how the light coming into your eye changes as you act upon the red piece of paper."

This provides an explanation behind why people sometimes see the same object in different colours. Christoph Witzel has shown this for a prominent recent example: the photo of a particular dress that provoked debate around the world as to whether it was gold and white, or blue and black. O'Regan says that these different viewpoints are predicted precisely by sensorimotor theory. "Even though you have the same wavelengths of light coming into your eye as somebody else, you may see the colour as being different from the way that person sees it. Wavelength is not colour," he stresses. The way an individual sees the dress is also strongly determined by what assumptions he makes about the colour of the light that is illuminating the dress. "An individual might assume that the dress is illuminated by direct sunlight. Alternatively he might assume the dress is in the shadow. Depending on what you assume about the light, your brain will deduce that the material is different and so actually see its colour as being different," points out O'Regan.

Sensory substitution is a method by which you can replace one sense by another. For example, you might be able to use the skin to get input which provides you with visual sensations, or you might be able to use the ears to get input that gives you tactile sensations

The project will continue its research into fundamental questions around colour, sensory substitution and infant development in future, as well as working to improve sensory substitution devices. "We're now experimenting with a device that gives people a sense of North – we aim to see whether it helps to improve people's navigational abilities," says O'Regan. Researchers will also continue to develop the sensorimotor theory, which could then act as a theoretical framework for further research. "The project will go on for another two years, and we hope to develop a fully-fledged theory of feel," says O'Regan.



A robotic agent acquiring the notion of space and its topology by detecting coincidences in its sensory information (Copyright © Terekhov AV and O'Regan JK 2016). Space as an Invention of Active Agents. Front. Robot. AI 3:4. doi: 10.3389/frobt.2016.00004 (Copyright © 2016 Terekhov and O'Regan).

At a glance

Full Project Title
A sensorimotor approach to understanding consciousness (Feel)

Project Objectives
In addition to investigating the philosophical implications of the "sensorimotor" approach to consciousness and making links to robotic applications, we are doing experiments to verify the theory's predictions about why certain colours are perceived as special, about how infants develop the sense of their own body, and about how one might be able to perceive the direction of North through hearing.

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Kevin O'Regan started his career in experimental psychology studying eye movements in reading and visual perception. He was director of the University Paris Descartes Psychology of Perception Laboratory for 12 years, and most recently received a large European Research Council Advanced grant called "FEEL" to investigate a "sensorimotor" theory of consciousness which he has developed.

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