Outside the body, inside the brain

Out-of-body experiences may be a consequence of an 'irritable cortex'.

Jason Braithwaite runs a popular third-year undergraduate course entitled 'The Lying Brain'. "It's about how the brain can make you believe the palpably untrue," he explains. His research touches upon one intriguing example – the out-of-body experience, where people perceive themselves to be situated outside their physical bodies.

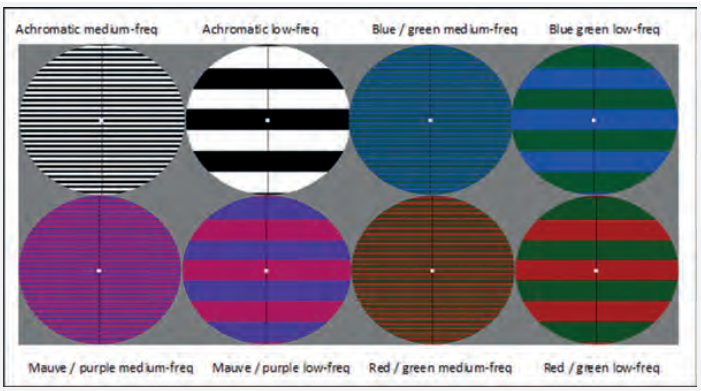
A better understanding of out-of-body experiences may shed light on more typical and stable 'in-the-body experiences' – how we perceive ourselves as physical forms. The prevailing idea is that this relies on the brain's integration of information from multiple senses – such as vision, touch and internal states (interoception). Abnormalities in this integration may underlie the 'anomalous bodily experiences' experienced by certain clinical populations, such as those with brain damage, epilepsy or schizophrenia.

How these relate to more every-day experiences is unclear, however. Dr Braithwaite has therefore focused on a non-clinical group – students. Around one in four students report anomalous physical sensations such as out-of-body experiences (curiously, rather more than the population estimates of 10–15 per cent). Initial studies pointed to a role for temporal lobe instability, an area known to be involved in body ownership and abnormal body perceptions. To delve deeper, he turned to the 'pattern glare' test, where subjects view gratings that vary in the density (i.e. frequency) of stripes.

"People may wonder, 'what on earth do stripy patterns have to do with high-level, fantastic and spectacular hallucinations?'" says Dr Braithwaite. However, there is more to the stripy patterns than first meets the eye: "They are very potent visual images." As well as being unpleasant for many to look at, they can induce a range of visual perceptual anomalies, trigger epileptic fits, and generate anomalous somatic sensations (nausea, dizziness, eye strain).

Notably, this 'visual irritability' is restricted to gratings of certain spatial frequencies. Dr Braithwaite found that students who had experienced visual out-of-body experiences reacted no differently than control groups to non-irritable stimuli, but were much more sensitive to the critical medium frequency of unpleasant stripes. "The OBE group report many more visual distortions and somatic effects than you and I would, suggesting that their cortex is really struggling to deal with the irritability induced by the grating."

The reason, he suggests, is that the visual association cortex of such individuals is 'hyperexcitable' and becomes over-stimulated by unpleasant visual stimuli. Furthermore, the physical impact suggests that hyperexcitability may also extend to somatosensory cortex.



Visual stimuli used in the 'pattern glare' test.

Cortical thunderstorms

Dr Braithwaite believes that cortical excitability renders certain people vulnerable to the triggering of temporary 'microseizures'. "If they happen at the right time in the right part of the brain, you have all the ingredients for an anomalous perception."

Although speculative, he has developed a model to explain what might be happening. "Our working hypothesis is that these 'thunderstorms' impact on the temporal integration of incoming signals, inducing some form of dysconnection between the senses. The brain is trying to bind a coherent sense of self together, hundred of times a second, but if it has to work with degraded information or even without all the necessary information altogether, that's when anomalous perceptions can happen."

Recent work with the rubber hand illusion supports this idea, and argues against the intuitively attractive idea that individuals susceptible to bodily illusions have a 'weak' or particularly malleable sense of body image. "All the research with schizophrenics says these people get the illusion stronger and earlier. With improved methodologies, we find the complete opposite."

As well as taking longer to experience the illusion, the OBE groups also respond less when the rubber hand is threatened with a fake injection. Curiously, however, they are more susceptible to experiencing the illusion in the asynchronous brushing condition, possibly because of a bias in the integration of visual and tactile signals.

Dr Braithwaite is keen to test the disrupted (dysconnection) temporal integration theory further in non-clinical groups. An additional aim is to examine its potential implications for patients who experience highly disabling visual hallucinations and delusions.

Braithwaite JJ *et al.* Signs of increased cortical hyperexcitability selectively associated with spontaneous anomalous bodily experiences in a nonclinical population. *Cogn Neuropsychiatry*. 2013 [Epub ahead of print]
Braithwaite JJ, Broglia E, Bagshaw AP, Wilkins AJ. Evidence for elevated cortical hyperexcitability and its association with out-of-body experiences in the non-clinical population: new findings from a pattern-glare task. *Cortex*. 2013;49(3):793–805