Ecstatic epilepsy: How seizures can be bliss

24 January 2014 by **Anil Ananthaswamy**
Magazine issue 2953. **Subscribe and save**
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(Image: Susan Kay/Millennium Images)

Some epileptic seizures are blissful. Understanding why might shed light on religious awakenings, joy, and the sense of self

IT WAS one of the most profound experiences of Fyodor Dostoevsky's life. "A happiness unthinkable in the normal state and unimaginable for anyone who hasn't experienced it... I am then in perfect harmony with myself and the entire universe," he told his friend, Russian philosopher Nikolai Strakhov. What lay behind such feelings? The description might suggest a religious awakening – but Dostoevsky was instead describing the moments before a full-blown epileptic seizure.

Those sensations seem to have informed the character of Prince Myshkin in Dostoevsky's novel, *The Idiot*. "I would give my whole life for this one instant," the prince says of the brief moment at the start of his epileptic fit – a moment "overflowing with unbounded joy and rapture, ecstatic devotion, and completest life".

For a long time, the novelist was thought to be exercising his artistic licence and exaggerating this "ecstatic aura", rather than accurately representing a real phenomenon. Most epileptic attacks are terrifying, after all, and many people with epilepsy would give a lot not to experience another. But as more and more people with the condition have come forward reporting the same feelings, there has been a renewed interest in this "Dostoevsky syndrome" – and neuroscientists are now on the hunt for the cause.

Besides explaining those feelings of bliss experienced by Dostoevsky and other people with "ecstatic epilepsy", their investigations could also open a window on self-awareness more generally. The question is, are there safe ways we could all be transported to similar states of being?

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Epileptic seizures are broadly divided into two groups: generalised and focal. In generalised seizures, electrical discharges overwhelm the outer layer of the brain, the cortex, and often lead to loss of consciousness. Ecstatic seizures seem to be of the second kind. In focal or partial epilepsy the electrical storm is confined to a small region of the brain and the person usually remains conscious. This type of seizure can turn into a generalised one if the errant electrical signals spread.

Despite Dostoevsky's famous accounts, records of ecstatic feelings among other people with epilepsy have been scarce – perhaps because this kind of seizure is rare, but also because people are reluctant to divulge such personal feelings. "I think that they are probably underestimated," says Fabienne Picard, a neurologist at the University Hospital in Geneva, Switzerland. "Because the emotions are so strong and strange, maybe they feel embarrassed to speak about them; maybe they think the doctor will find them mad."

Picard's interest in the subject was piqued when she came across Dostoevsky's writings while making the film *Art & Epilepsy*. She soon realised that some of her patients were having very similar experiences. "When they really explained their feelings, it was incredible," says Picard. "It was very close to Dostoevsky's descriptions."

Unbelievable harmony

As Picard cajoled her patients to speak up about their ecstatic seizures, she found that their sensations could be characterised using three broad categories of feelings (*Epilepsy & Behaviour*, vol 16, p 539). The first was heightened self-awareness. For example, a 53-year-old female teacher told Picard: "During the seizure it is as if I were very, very conscious, more aware, and the sensations, everything seems bigger, overwhelming me." The second was a sense of physical well-being. A 37-year-old man described it as "a sensation of velvet, as if I were sheltered from anything negative". The third was intense positive emotions, best articulated by a 64-year-old woman: "The immense joy that fills me is above physical sensations. It is a feeling of total presence, an absolute integration of myself, a feeling of unbelievable harmony of my whole body and myself with life, with the world, with the 'All'," she said.

When I met another one of Picard's patients, a 41-year-old Spanish architect, she talked of that same connectedness. "You are just feeling energy and all your senses," she said. "You take in everything that is around, you get a fusion."

As Picard began looking for the neurological origin of the disorder, such descriptions pointed her towards the insula – a region of the cortex that is of growing interest to scientists studying consciousness. It is buried inside the fissure dividing the frontal and parietal lobes from the temporal lobe, and its main function seems to be to integrate "interoceptive" signals from inside the body, such as the heartbeat, with "exteroceptive" signals such as the sensation of touch.

There is also evidence that the processing of these signals gets progressively more sophisticated looking from the back of the insula to the front. The portion of the insula closest to the back of the head deals with objective properties, such as body temperature, and the front portion, or anterior insula, produces subjective feelings of body states and emotions, both good and bad. In other words, the anterior insula is responsible for how we feel about our body and ourselves, helping to create a conscious feeling of "being". This led Bud Craig at the Barrow Neurological Institute in Phoenix, Arizona, to argue that this part of the brain is the key to "the ultimate representation of all of one's feelings – that is, the sentient self".

Mapping ecstasy

The altered self-awareness that Picard's patients experienced would certainly implicate the anterior insula in ecstatic epilepsy – but more direct evidence was difficult to come by. Over the past few years, Craig, Picard and their colleagues have managed to find a few people with ecstatic epilepsy who agreed to have their brains imaged during seizures. The researchers injected the patients with "nuclear tracers", which accumulate in different parts of the body and are detected using a device called a gamma camera. Areas with higher blood flow absorb more of the tracer, and the scans revealed increased blood flow – which is assumed to reflect higher neuronal activity – at or near the anterior insula during seizures (*Cortex*, vol 49, p 2494).

But such imaging studies cannot be conclusive because they cannot pinpoint the hyperactive regions

precisely. It takes about 30 seconds for active brain regions to absorb the tracers, but seizures usually spread rapidly to many different regions, making it difficult to locate their origins with certainty.

More concrete proof didn't come until March last year. I was visiting Picard in her office in Geneva at the time, when she received an email from Fabrice Bartolomei, a neurologist at Timone Hospital in Marseille, France. Bartolomei's surgical team had implanted electrodes inside the brain of a young woman suffering from epilepsy with episodes of ecstatic seizures. Bartolomei's message read, "We have explored the patient... The stimulations in the anterior insula trigger a pleasant sensation of floating and chills." Picard shot off a quick reply: "I'm so happy!"

Bartolomei's patient was a 23-year-old woman. She started having seizures when she was 15, and stopped going to school as a result. She also had a difficult personality with aggressive, sociopathic tendencies. Even so, before her seizures rendered her unconscious, they always began with moments of ecstasy, much like Dostoevsky's.

Because drugs were not effective in treating the woman's epilepsy, she gave Bartolomei the go ahead to insert electrodes into her brain to find the focus of the seizures and possibly surgically remove the tissue that was setting off the attacks. Bartolomei's measurements suggested that the seizures began in the temporal lobe but spread to the anterior insula in less than a second – supporting the idea that hyperactivity in this region was triggering the blissful feelings that preceded the generalised seizure.

Next, Bartolomei used the electrodes to stimulate the young woman's brain in specific places. The technique allows surgeons to double-check that they have found the cause of the seizure, and helps prevent them damaging or cutting away any key brain tissue. It is also the best way to determine the function of different brain regions. Much of what we have learned about the brain has come from people who have undergone this kind of exploration while conscious.

Unfortunately, the procedure can be uncomfortable, which caused Bartolomei's patient to become aggressive. But when the electrode in the anterior insula was activated, her feelings changed. "I feel really well with a very pleasant funny sensation of floating and a sweet shiver in my arms," she said. These sensations were identical to the ecstatic aura that usually accompanied her epilepsy, she said. Based on these tests, Bartolomei has suggested surgery, but the woman has opted against it. The experiences nevertheless gave Picard some much needed evidence of the anterior insula's role in ecstatic seizures (*Cortex*, vol 49, p 2935).

More studies will be needed to confirm the effect, but Anil Seth, a neuroscientist at the University of Sussex in Brighton, UK, is impressed by these findings. "The fact that the direct electrical stimulation of the insula does elicit these kinds of feelings is pretty compelling," he says. He studies people with depersonalisation and derealisation disorders, which are associated with a dysfunctional or underactive insula, and they describe the world as being drained of sensory and perceptual reality. In a way, a hyperactive insula during ecstatic seizures produces the opposite effect, he says.

Investigating how abnormal activity in the anterior insula leads to disorders like ecstatic epilepsy might also help scientists establish how this region creates our normal experience of self-awareness. Picard's patients reported feelings of certainty – the sense that all is right with the world – which would seem to fit with a theory that the anterior insula is involved in predicting the way the body is going to feel in the next instant. Those predictions are then compared with actual sensations, generating a "prediction error" signal that might help to determine how we react to a changing environment. If the prediction error is small, we feel good, if it is large we feel anxious. It is possible that the electrical storm in the anterior insula may be disrupting the comparator mechanism, causing there to be no prediction error. As a result, the person is left feeling as if nothing is wrong with the world, that everything makes sense.

Besides the sense of expanded awareness and certainty, people like Dostoevsky have also recorded the strange sense that time is slowing down during their seizures. This might reflect the way the insula samples our senses. Craig argues that the anterior insula usually combines interoceptive, exteroceptive and emotional states to create a discrete "global emotional moment" every 125 milliseconds or so – dividing our feelings into separate frames, like a film reel. He posits that a hyperactive anterior insula may generate these global emotional moments faster and faster, leading to a sense that time is slowing.

Under fire

It is uncanny how these feelings of serenity, heightened awareness and a slowing of time also underpin apparent religious experiences. Have mystics over the ages been having ecstatic seizures?

Picard's patients could see why some might attribute religious meaning to their seizures. "Some of my patients told me that although they are agnostic, they could understand that after such a seizure you can have faith, belief, because it has some spiritual meaning," she says.

Needless to say, our understanding of this crucial brain region and its role in ecstatic epilepsy is still in its early stages. Neuro-imaging studies sometimes come under fire for over-simplifying complex brain mechanisms by pinning them to single regions – and some might argue that the recent work on the insula is no different. Most experiences, after all, are the result of complex networks of activity.

It is important to recognise, for instance, that the insula is responsible for bad feelings as well as good, with studies showing that it is often highly active during feelings of anxiety. So it will be crucial to understand exactly what sort of activity contributes to each feeling.

That may depend on what's going on elsewhere in the brain, but a better understanding may also come with more detailed maps of the insula itself. There is some evidence that the left side is more relevant for the positive feelings in question, whereas the activation of the right-hand side may be more closely linked to negative feelings. Tellingly, some people experiencing ecstatic epilepsy report alternating pleasant and unpleasant sensations – so scanning them during a seizure might help researchers to elucidate the basis of such emotions in more detail. Researchers could then work out how the different parts of the insula interact with each other and function within broader brain networks to produce everyday experiences.

We could also gain insights into the insula's role by other means. Craig and Picard think that feelings evoked by drugs like amphetamine, ecstasy and cocaine may share many similarities with ecstatic epilepsy. These chemicals usually trigger a flush of neurotransmitters through the brain, and there is evidence that, following drug use, levels of dopamine in the anterior insula are unusually high relative to other regions. The neurotransmitter serotonin may be similarly implicated in the case of ayahuasca, a psychedelic brew long associated with shamanistic rituals in the Amazon. Again, nuclear imaging results show increased blood flow in the anterior insula about 100 minutes after consumption.

Fortunately, there may be safer ways to come close to the same feelings. Meditators often experience the time-slowing, heightened self-awareness and feelings of profound well-being that come with Dostoevsky syndrome. In 2007, Richard Davidson of the University of Wisconsin in Madison and colleagues studied 15 expert and 15 novice meditators. They found that the deeper the meditative state, the greater the activity in the anterior insula.

If that does reflect the same "unbounded joy and rapture" that Dostoevsky's Prince Myshkin reported, it certainly doesn't come easily: the experienced meditators had logged more than 10,000 hours of practice to see these effects. You may not need to give your "whole life for this one instant", as Prince Myshkin put it – but it may not be far off.

This article appeared in print under the headline "Fits of rapture"

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From issue 2953 of New Scientist magazine, page 44-47.

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