Brain 'seismology' helps predict epileptic attacks

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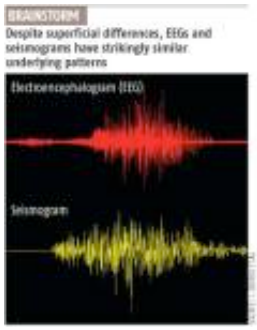
They both start with tiny, barely perceptible tremors that lead up to a cataclysmic climax - and now it seems that the similarities between earthquakes and epileptic seizures run deep. Seismology could even hold the key to new ways of predicting and avoiding seizures.



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Brainstorm

A team led by neurologist Ivan Osorio of the University of Kansas in Kansas City compared the brain activity in 16,000 epileptic seizures with seismological data from 300,000 earthquakes. The team concludes in a non-peer-reviewed report (www.arxiv.org/abs/0712.3929) that the dynamics of the two kinds of event are very similar (see Diagram).

There are several striking features in common. Low-level tremors that foreshadow full earthquakes, for example, are mirrored by tiny neural spikes in the brain's electrical activity before a seizure. Just as the low-level tremors were undetectable except with seismographs, so the neural spikes go unnoticed by patients but are measurable through scans of brain electrical activity.

Likewise, Osorio and his colleagues say that the patterns of "waiting times" were similar for earthquakes and seizures. Counter-intuitively, the longer the wait since a previous quake or seizure, the longer it is likely to be till the next one. Similarly, a "cluster" of quakes is usually preceded by only a short wait.

This pattern implies that past earthquakes - and seizures - affect future ones, casting doubt on the idea that they happen at random (*New Scientist*, 14 June 1997, p 19). "This suggests a novel research direction for the prediction of seizures based on the notion that seizures beget seizures," write the researchers.

Osorio's team traces the idea that quakes and seizures share the same dynamics back to 2002, but the paper is the first to demonstrate an element of predictability in seizures. As with earthquakes, they found that seizures are governed by "power laws", which often link superficially random events. In seismology, power laws describe the relationship between the magnitude of individual quakes and the frequency with which quakes of that magnitude occur, or the delay times between quakes.

Power laws also describe phenomena as obscure as the time taken to respond to emails, so the fact that they show up with quakes and seizures is not in itself surprising. But with seven separate power laws showing up in the data from both earthquakes and seizures, parallels between the phenomena are hard to ignore. The discovery may bring us closer to predicting and preventing seizures, Osorio's team concludes - a key goal of neuroscience.

"It's an attractive concept," says Matthew Walker of the experimental epilepsy group at University College London's Institute of Neurology. "A good predictive method could revolutionise people's lives," though he cautions that the team has yet to show that its method can provide this.

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From issue 2638 of New Scientist magazine, 12 January 2008, page 9

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