☑ **Fact-Checked Science**

PAPER CHECK · GEOMAGNETIC STORMS AND HEALTH

Storms, auroras and the brain: big claims, thin evidence

A 2026 GeoHealth review links geomagnetic storms to seizures, sleep, mood and even risks in neurosurgery, and suggests doctors plan around them. Its own key points call the evidence largely associative [1 Key Points]. Many of its sources turn out to be animal, cell or off-topic studies, none of them studies storms in people having surgery, and the physics says a storm's magnetic changes are small beside the fields we live with.

By Fact-Checked Science · Published October 13, 2026

OUR ANALYSIS marks our own reasoning and calculations, and the verdicts are our assessment. Everything else comes from the numbered sources.

Associations, stretched into advice for surgeons

OUR ASSESSMENT

0 of 89

Our count: none of the review's 89 references studies geomagnetic activity in people having surgery; the closest is a rat study [1][2].

0 of 4

Our reading: none of the four sources behind its seizure rating counts seizures in people. Two are rat studies [1 Table 2].

~1 nV/m

Our estimate of the most a very fast storm induces inside a head, about a millionth of the brain's own signals.

THE REVIEW'S CLAIMS

OVERSTATED

Storms affect seizures, sleep, cognition and mood

Abstract and conclusion [1 Abstract][1 §9]

Some observational associations exist, but the review's own key points call the evidence "largely associative," and two of the three "Moderate" ratings we checked rest on rat, cell or off-topic papers. See section 3.

UNSUPPORTED

Neurosurgeons should plan around storms

Monitoring, scheduling and consent
[1 §6.2][1 §6.4][1 §6.5]

None of its 89 references studies geomagnetic activity in people having surgery, and its source for weighing storms when scheduling surgery is a study of blood-pressure readings. See section 4.

UNSUPPORTED

Storms can disrupt MRI and EEG

Imaging and EEG in surgery [1 §6.3]

Its four sources concern cancer cells, field fluctuations recorded while scanning a static phantom, Arctic public health and brain activity in ten people. None shows a storm affecting a scanner or a recording, and the physics makes EEG noise implausible. See section 2.

MISLEADING

Auroras are becoming more common

Introduction, recommendations and conclusion
[1 §1][1 §7][1 §9]

The widespread auroras of 2024 came at the peak of the roughly 11-year solar cycle, which NASA and NOAA announced in October 2024. A peak isn't a lasting trend. See section 5.

1 · THE REVIEW

A narrative review that ends in advice for neurosurgeons

Seven authors reviewed studies of geomagnetic activity and health published from 1990 to 2025, rated the evidence for each body system and drew out what it might mean for patients facing neurosurgery or a neurological or psychiatric assessment [1 Abstract][1 §2]. They chose a narrative review because the literature was too limited and varied for a systematic one [1 §2].

In the review's words GMA is geomagnetic activity; GMDs are geomagnetic disturbances.

> *"Reported associations included: increased seizure frequency in patients with epilepsy, sleep disturbances affecting recovery, and cognitive impairments that may complicate patient consent processes."*
>
> Sethi et al. (2026) [1 Abstract]

> *"Neurosurgeons may need to avoid scheduling critical surgeries during periods of particularly high GMA to minimize potential risks and optimize recovery."*
>
> Sethi et al. (2026) [1 §6.5]

> *"Current evidence remains largely associative, highlighting the need for mechanistic and longitudinal studies to clarify clinical relevance"*
>
> Sethi et al. (2026), Key Points
> [1 Key Points]

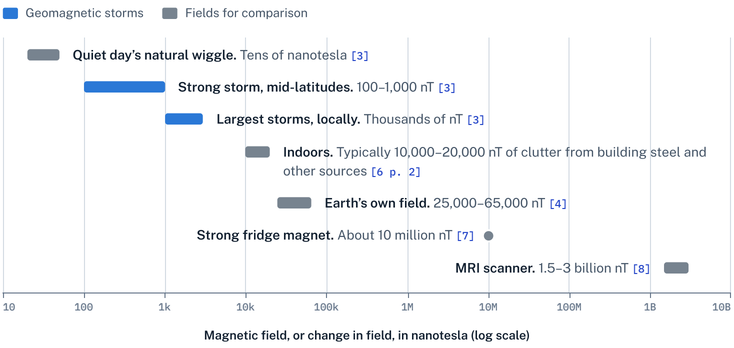
The review treats auroras as a sign of geomagnetic disturbance, not a cause: "Auroras therefore represent epiphenomena — visual correlates of underlying GMDs — rather than independent biological exposures" [1 §1]. Quotations from the review use ordinary hyphens where its online text has a typographic variant.

2 · THE PHYSICS

A storm's magnetic change is small beside the fields we live in

Even a big storm moves the field at the ground by hundreds to a few thousand nanotesla [3], no more than about a tenth of Earth's own field, and usually much less [4]. That matters for power lines hundreds of kilometres long, where it can drive currents into the grid [5]. For a body, the magnetic clutter in an ordinary building is larger [6 p. 2].

How big is a storm's magnetic change?

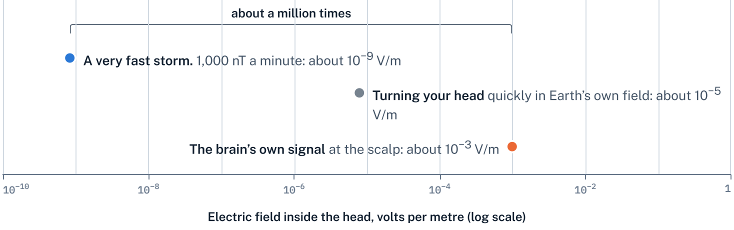


Values from the numbered sources; storm and indoor values vary from place to place. The British Geological Survey gives tens of nanotesla (nT) a day and "100 to 1000s of nT during magnetic storms" at UK sites [3]; splitting storms into strong and largest is our compilation. A strong refrigerator magnet is 100 gauss, or 0.01 tesla [7]; MRI scanners use 1.5 to 3 tesla [8]. One tesla is a billion nT.

Inside a head

Electric fields inside a head

OUR ANALYSIS



Our estimates from Faraday's law for a loop of 10 cm radius, except the brain's own signal, which is scalp EEG of 10–100 microvolts [9 p. 7] spread over a few centimetres. The head turn is 90° in half a second in a 50,000 nT field, at its fastest.

OUR ANALYSIS

A storm change of 1,000 nT a minute, more than twice the fastest the British Geological Survey quotes for the UK (400 nT a minute) and close to auroral-zone records [3], induces about a billionth of a volt per metre in a head-sized loop: 8×10^{-10} V/m for a 10 cm radius.

Scalp EEG signals are 10–100 microvolts [9 p. 7], roughly a thousandth of a volt per metre across a few centimetres, so even this extreme storm adds about a millionth of the brain's own signal. Signals recorded inside the skull are about ten times larger again [9 p. 7].

Turning your head quickly in Earth's own field induces thousands of times more than the storm does.

Two technical claims without evidence

Storms and MRI

The review says imaging "can be affected by GMDs" and that storms "may theoretically" introduce field variability that would complicate surgical planning, "although direct clinical evidence remains limited" [1 §6.3]. Its two sources don't involve storms: one is a study of cancer cells in an artificial magnetic field [10], the other a study of field fluctuations recorded while scanning a static phantom, which doesn't mention storms [11].

OUR ANALYSIS A storm shifts the field by at most a few thousand nT, over minutes to hours: at most about two parts per million of a 1.5-tesla magnet [8]. MRI does respond to very small field shifts, so size alone doesn't rule out an effect, but the review offers no measurement of a storm affecting a scanner.

Storms and EEG

The review says storms "introduce noise into EEG signals, making it difficult to interpret results and potentially leading to misdiagnosis or improper surgical interventions" [1 §6.3]. Its sources are a review of public health in the Russian Arctic [12] and a study relating EEG patterns to geomagnetic activity in ten people, which is about brain activity, not noise [13].

OUR ANALYSIS The induced field is about a millionth of the brain's own. A storm's field changes mostly over minutes to hours, while EEG is read in bands from 0.5 to 80 cycles a second, and recordings are routinely filtered to remove drifts slower than about one cycle a second [9 §2.3][9 §5.1.1].

3 · THE EVIDENCE RATINGS

The ratings rest on animal, cell and off-topic papers

The review says it rated the evidence in its Tables 1 and 2 with the GRADE approach [1 §2]. We compared five of its ratings with the studies it cites for them. The last two columns are ours.

The review's ratings beside what it cites

OUTCOME	REVIEW'S RATING	WHAT IT CITES OUR ANALYSIS	GRADE STARTING POINT OUR ANALYSIS
Heart attacks, blood pressure	"Strong" [1 Table 1]	One 2002 paper summarizing earlier studies [14]. The review's own definition of "Strong" needs several large studies [1 §2].	Low
Psychiatric admissions, suicide	"Moderate" [1 Table 2]	Four references: three reporting time-series or population correlations, and a study of how traditional healers in South Africa explain mental illness, which isn't about geomagnetic activity [15].	Low
Seizures	"Moderate" [1 Table 2]	Four references: two rat studies, one on anaesthetic sedation [2] and one on deaths of epileptic rats under simulated storm fields [16], a review [17] and a heart paper [14].	Low
Inflammation markers	"Moderate" [1 Table 1]	Three references: a cell study of 50 Hz fields [18], a review of electromagnetic fields and the immune system [19] and a paper on the ionosphere during a 2017 storm [20]. None measures inflammation in people.	Low
Hormones, cognition, anxiety	"Emerging" [1 Table 1][1 Table 2]	A rating the methods never define [1 §2].	Low

"What it cites" is our reading of the cited papers' titles and abstracts. Starting points follow GRADE's rule for observational evidence [21]. Where a row rests on animal studies, GRADE would in general rate the evidence down two levels for indirectness [22 §5.2.3].

OUR ANALYSIS

GRADE rates the certainty of evidence as high, moderate, low or very low. Randomized trials start as high and observational studies as low [21]. Observational evidence is rated up only for a large effect, a dose–response gradient, or when plausible confounding would have weakened the effect, and rarely when the studies have serious limitations [22 §5.3]. "Strong" is GRADE's word for a recommendation, not for evidence [22 §6.1.1].

A full GRADE rating would also mark these rows down for indirectness, since much of the cited work is on animals, cells or other topics, so most would probably end at very low. Even by the review's own definition, "Strong" needs "multiple well-conducted randomized clinical trials, meta-analyses, or large cohorts with consistent results" [1 §2].

4 · THE LEAP TO THE OPERATING ROOM

From population associations to surgical advice, with no study in between

None of the review's 89 references studies geomagnetic activity in people having surgery. The closest is a retrospective study of anaesthetic sedation in laboratory rats undergoing surgery [2]. The review itself calls the subject "an emerging area of research interest, with much still unknown" [1 §7].

WHAT THE LITERATURE OFFERS

Associations in general populations

Heart-rate variability, blood pressure, hospital admissions, strokes and suicides, mostly correlational. The review says such studies are "inherently limited by their inability to establish causality" [1 §8].

WHAT THE REVIEW SUGGESTS

Monitoring, scheduling, consent

"Heightened vigilance," avoiding critical surgery during high geomagnetic activity, and warnings that storms may complicate consent [1 §6.4][1 §6.5][1 §6.2].

THE MISSING LINK

Assumed to apply to surgical patients

Its claim that storms have been shown to worsen anxiety in neurosurgical patients before and after surgery cites a general review whose abstract doesn't mention surgery [1 §6.1][23]. Its case for weighing storms when scheduling surgery cites a study of blood-pressure readings in two Chinese cities [1 §6.5][24].

OUR ANALYSIS

The consent worry rests on one study [1 §6.2]. Among about 1,100 older men in the Boston area, a typical day-to-day rise in geomagnetic activity went with 19% higher odds of a low score on a cognitive screening test [25]. That is everyday variation rather than storms, a screening cut-off rather than a judgment of capacity, and nothing about surgery.

Acting on the review's advice could cause real harm: delayed operations, needless anxiety, or doubts about a patient's capacity based on a space-weather forecast.

5 · OUR ASSESSMENT

Where the review falls short, and where it deserves credit

This section is our assessment of the review, checked against the sources it cites.

OUR ANALYSIS

Leaning on weak sources

Several claims rest on Michael Persinger's work, including the uncited claim that weak magnetic fields can induce "experiential phenomena" [1 §3.9]. That effect failed an independent double-blind replication with a sham control in 2005 [26], a result Persinger disputed [27]. Others rest on animal studies using artificial laboratory fields rather than real storms [16].

OUR ANALYSIS

Citations that say something else

Beyond the ratings table and the claims about MRI, EEG and surgery, the pattern continues. A rat experiment on depression and melatonin is credited to a review of melatonin trials in people [1 §3.6][28]. A study of cognition in older men, with data from 1992 to 2013, is cited both for the auroras of 2024 and for a rise in seizure activity [1 §5][1 §6.1][25]. We checked titles and abstracts, not every full text.

OUR ANALYSIS

A mostly null result, not weighed

The review’s own Table 3 includes a study in which links between geomagnetic activity and heart-rate variability mostly vanished after correction for autocorrelation, and notes that earlier findings “may be overstated” [1 Table 3][29]. Its text still presents the link as documented [1 §1][1 §3.1].

OUR ANALYSIS

Claims without citations

Spikes in hospital admissions and deaths among the elderly during storms, and raised reactive oxygen species observed during storms, are asserted without a source [1 §4][1 §3.8].

OUR ANALYSIS

Many tests, few controls

The Australian suicide finding appears only in women and only in autumn [1 Table 3][30]. If both sexes and all four seasons were tested, the chance of at least one such result by luck alone would be about one in three, and its P = 0.01 wouldn’t pass a correction for eight tests. The review never discusses multiple comparisons.

OUR ANALYSIS

Auroras aren’t trending up

The review mostly frames mid-latitude auroras as increasingly common [1 §1][1 §6.5], though it mentions the 11-year cycle once [1 §7]. The 2024 displays came at solar maximum, which NASA and NOAA announced in October 2024 [31]. Such auroras should grow rarer as the cycle heads toward its minimum, though big storms stay common for a few years after the peak [3].

Credit where it’s due

The review treats auroras as a visible sign rather than a cause, calls its evidence largely associative, and admits small samples and confounding [1 §1][1 Key Points][1 §8]. Its conclusions and recommendations don’t follow that caution [1 §6.5][1 §9].

6 · WHAT HOLDS UP

A few large studies are worth taking seriously

The largest studies of storms and health concern the heart and circulation, and even there the results are mixed [32 p. 1639][33].

Stroke and heart deaths

The multi-country stroke study the review cites covered 11,453 patients with stroke. Geomagnetic storms, with a planetary index (Ap) of 60 or more, were associated with a 19% higher risk of stroke (95% confidence interval 11–27%) [32 p. 1639][1 Table 3]. That is a relative increase.

A study of 263 U.S. cities found links between geomagnetic disturbances and total, cardiovascular and heart-attack deaths, but not stroke deaths [33].

OUR ANALYSIS

Days with Ap of 60 or more made up about 2% of days in 1981–2004 [34]. So even if the stroke link were causal, and the extra risk fell only on storm days, storms would account for well under 1% of strokes, about 0.4%.

The stroke study compared each patient’s stroke day with other days in the same time window, a design that takes care of season [32 p. 1639]. The remaining worries are chance findings from many comparisons, results that differ between studies, and weather, all of which need ruling out before the magnetic field itself.

What would settle it

01
Pre-registered studies at several sites that fix their outcomes and time windows in advance, control for season and weather, and report null results.

02
Any study of geomagnetic activity in people having surgery at all, before advice for the operating room, as the review itself proposes [1 §7].

03
A mechanism that explains how changes this small, at most about a tenth of Earth’s field and smaller than the clutter inside a building, could reach the body.

7 · BOTTOM LINE

A question worth studying, not a basis for clinical practice

OUR ANALYSIS

The review’s key points are the honest part: the evidence is “largely associative,” and mechanisms still need study [1 Key Points]. None of its 89 references studies geomagnetic activity in people having surgery, so the neurosurgical advice built on them has no direct support.

Limits of this check

The review’s sources, not the whole field

We checked the studies the review cites. We didn’t search the wider literature for studies of surgery and geomagnetic activity, so “none” means none among its 89 references.

Our estimates are simple

The induced fields come from Faraday’s law for a loop in a uniform field. A detailed model of a head would change the numbers somewhat, but not by the factor of a million that separates a storm from the brain’s own signals.

Abstracts for many cited papers

We read the review in full, but for most of the papers it cites, including the stroke study, we read only titles and abstracts.

Related checks

UNSUPPORTED The Sun and wars, crime and revolutions The Disaster Cycle, Fact-Checked

FALSE More auroras from less solar input? The Disaster Cycle, Fact-Checked

Sources

Bracketed numbers refer to this list; § gives a section, p. a page and Table a table of the source. The review [1] has no page numbers in the version we read: Abstract and Key Points are its named parts, and §1–§9 its numbered sections. Links checked October 13, 2026.

1 Sethi, Y., Vora, V., Verma, A., Bhatt, R., Chaudhary, M. S., Chopra, H., and Greig, N. H. (2026). Aurora-Associated Geomagnetic Activity and Health: A Review With Focus on Neurological Implications. *GeoHealth* 10(6), e2025GH001710. Published online June 22, 2026. Open access, CC BY 4.0. We read the PubMed Central version (PMC13284886), which has no page numbers.

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4 NOAA National Centers for Environmental Information. Geomagnetism Frequently Asked Questions. Accessed October 13, 2026.

5 British Geological Survey (2024). Will 2024 be the Year of the Aurora? News, February 23, 2024.

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7 National High Magnetic Field Laboratory. Tesla Definition. MagLab Dictionary. Accessed October 13, 2026.

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13 Kanunikov, I. E., and Kiselev, B. V. (2014). Influence of the geomagnetic field on recurrence quantification EEG indexes. *Ekologiya cheloveka (Human Ecology)* 21(12), 47–54.

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15 Sorsdahl, K. R., Flisher, A. J., Wilson, Z., and Stein, D. J. (2010). Explanatory models of mental disorders and treatment practices among traditional healers in Mpumulanga, South Africa. *African Journal of Psychiatry* 13(4), 284–290.

16 Persinger, M. A., McKay, B. E., O’Donovan, C. A., and Koren, S. A. (2005). Sudden death in epileptic rats exposed to nocturnal magnetic fields that simulate the shape and the intensity of sudden changes in geomagnetic activity: an experiment in response to Schnabel, Beblo and May. *International Journal of Biometeorology* 49(4), 256–261.

17 Guo, Y., Liu, Y., and Wang, X. (2020). Electromagnetic activity: a possible player in epilepsy. *Acta*

18 Benassi, B., Filomeni, G., Montagna, C., Merla, C., Lopresto, V., Pinto, R., Marino, C., and Consales, C.

Epileptologica 2, 9. CC BY 4.0.

(2016). Extremely Low Frequency Magnetic Field (ELF-MF) Exposure Sensitizes SH-SY5Y Cells to the Pro-Parkinson's Disease Toxin MPP$^+$. *Molecular Neurobiology* 53(6), 4247–4260.

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27 Persinger, M. A., and Koren, S. A. (2005). A response to Granqvist et al. "Sensed presence and mystical experiences are predicted by suggestibility, not by the application of transcranial weak magnetic fields". *Neuroscience Letters* 380(3), 346–347.

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29 Mattoni, M., Ahn, S., Fröhlich, C., and Fröhlich, F. (2020). Exploring the relationship between geomagnetic activity and human heart rate variability. *European Journal of Applied Physiology* 120(6), 1371–1381.

30 Berk, M., Dodd, S., and Henry, M. (2006). Do ambient electromagnetic fields affect behaviour? A demonstration of the relationship between geomagnetic storm activity and suicide. *Bioelectromagnetics* 27(2), 151–155.

31 NOAA Space Weather Prediction Center (2024). Joint Solar Maximum Announcement from NASA and NOAA. Posted October 16, 2024.

32 Feigin, V. L., Parmar, P. G., Barker-Collo, S., Bennett, D. A., Anderson, C. S., Thrift, A. G., Stegmayr, B., Rothwell, P. M., Giroud, M., Bejot, Y., Carvil, P., Krishnamurthi, R., and Kasabov, N. (2014). Geomagnetic storms can trigger stroke: evidence from 6 large population-based studies in Europe and Australasia. *Stroke* 45(6), 1639–1645.

33 Zilli Vieira, C. L., Alvares, D., Blomberg, A., Schwartz, J., Coull, B., Huang, S., and Koutrakis, P. (2019). Geomagnetic disturbances driven by solar activity enhance total and cardiovascular mortality risk in 263 U.S. cities. *Environmental Health* 18, 83. CC BY 4.0.

34 NOAA National Centers for Environmental Information. Geomagnetic kp and ap Indices, with yearly files of the GFZ Potsdam indices for 1981–2004. Accessed October 13, 2026.

METHOD

How this was checked

On October 13, 2026, we checked every statement, number, quotation and citation on the original infographic against its source: 81 items, including the review's full text in PubMed Central and the abstracts of the studies it cites for each point we discuss. We re-derived the induced-field estimate and the other calculations, and measured the original charts against their labels. The check corrected several statements; the change log lists them.

After the page was built, a second reviewer who hadn't seen the drafting checked it against fresh copies of the review, 36 of its references and the physics sources, and recomputed every calculation and chart mark; all reproduced. The changes that followed: a storm can change the field by up to about a tenth of Earth's own, not "a few percent", as NOAA puts it; the page now says that no reference studies storms in people having surgery, since one is a study of rats in surgery; the review's claim that storms worsen anxiety in neurosurgical patients is named; the psychiatric row no longer implies that all four references report correlations; the stroke result is given as the study's abstract states it; and a dozen smaller fixes.

The verdicts and the items tagged "Our analysis" are our own assessment, built on the cited sources: the induced-field and head-turn estimates, our reading of what the review cites and the GRADE starting points, the share of strokes on storm days and the chance of a subgroup result. The review is open access under CC BY 4.0 [1]; the charts are our own compilation from the numbered sources.

This page was researched and written with Claude, an AI assistant made by Anthropic, and then re-checked against its sources in a separate verification pass.

The verdicts on this page

MISLEADING	Contains something true but leaves a false impression, usually by leaving out key context.
OVERSTATED	Has some basis but claims much more than the evidence supports.
UNSUPPORTED	No evidence we could find backs it up, though it hasn't been strictly disproven.

All ten verdicts, and how we check

CORRECTIONS

Corrections and changes

If we get something wrong, we fix it and record the change below with the date. If a correction changes a verdict, the log says what the old verdict was.

Change log

Oct 13, 2026	Published on factchecked.science after a full check against the sources. Changes from the infographic: added our verdicts, on the site's scale, for four of the review's claims. The bottom line no longer credits the review's own summary with finding "no evidence at all" for the neurosurgical scenarios; the review calls the clinical evidence limited, and the absence of any study of surgical patients is our finding, among its 89 references. In the ratings table, the seizure and inflammation rows now say what the references are rather than "four studies" and "three studies," the 2002 heart source is a summary of earlier studies, the hormones row starts at Low, the two right-hand columns are marked as our analysis, and the GRADE note lists all three reasons to rate evidence up and says that "Strong" is GRADE's word for recommendations. The EEG point no longer cites the British Geological Survey bulletin, whose "tens of minutes" describes solar-flare effects in quiet times; it now rests on EEG's frequency bands and filtering. The MRI point no longer treats the ratio to the magnet as a physics refutation, since MRI responds to tiny field shifts; it now says the review's two sources don't involve storms, and the heading "Two claims that fail a physics check" became "Two technical claims without evidence." The 1,000 nT a minute in the induced-field estimate is now described as extreme, a storm moves the field by at most about a tenth of Earth's own and usually much less, and indoor clutter comes from building steel and other sources. The Table 3 heart study measured heart-rate variability, and the table itself notes earlier findings "may be overstated." The aurora point notes that the review mentions the 11-year cycle once and that big storms stay common after the peak. Persinger's dispute of the 2005 replication now cites his published response, and we added examples of citations that say something else. The 19% stroke figure is a relative increase on days with Ap of 60 or more, now cited to the stroke study itself, with our estimate that such days would account for about 0.4% of strokes and the 263-city study's finding of no link with stroke deaths; the confounding sentence now reflects the stroke study's design. "Caution about patients' capacity to consent" became "warnings that storms may complicate consent," with the study it rests on. Persinger's "God helmet" effects became his uncited claim of "experiential phenomena", and the MRI comparison "one part in ten million" became "two parts per million". We added the comparison with turning your head, and the limits of this check.

Fact-Checked Science is independent. It isn't affiliated with the channels, presenters or authors whose claims it checks.

Last updated Oct 13, 2026