Medical Xpress

Human 'neural compass' pinpointed in new study

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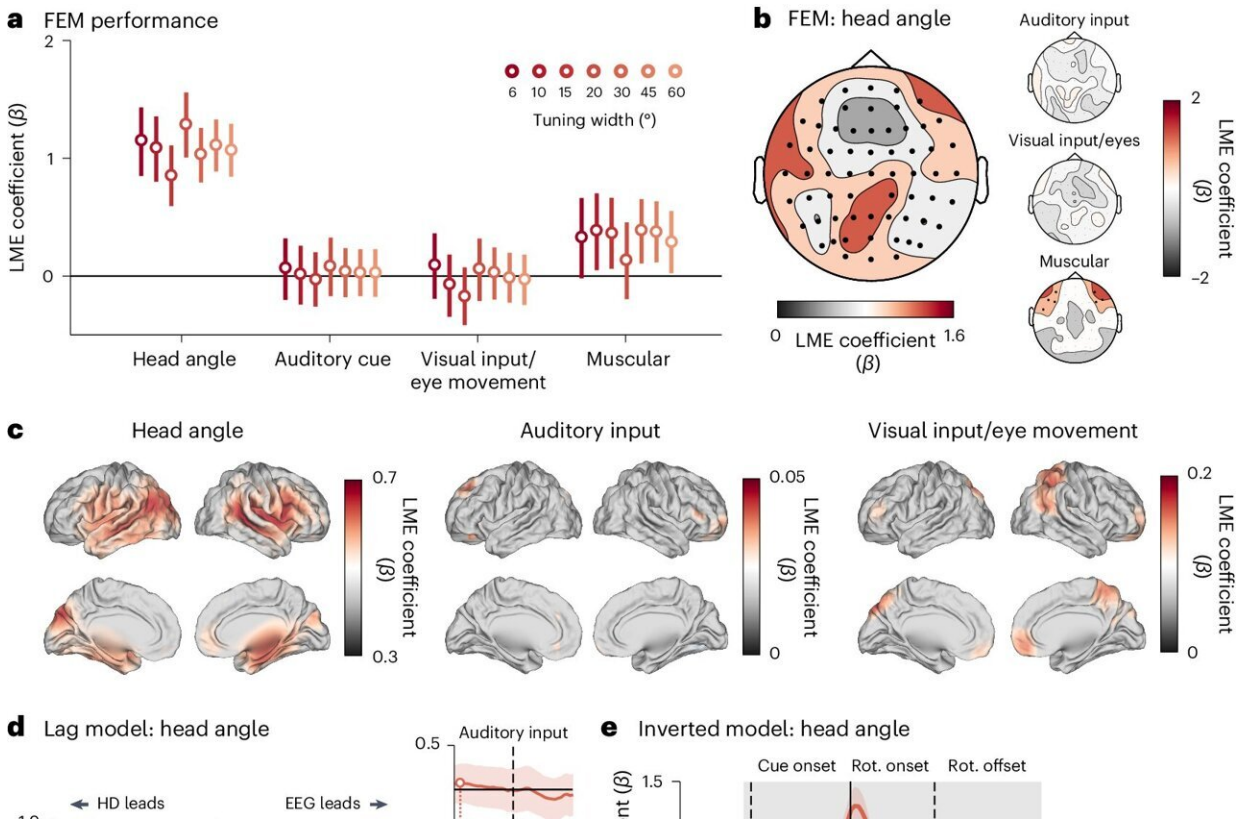

Electrophysiological activity tracks change in head angle. Credit: *Nature Human Behaviour* (2024). DOI: 10.1038/s41562-024-01872-1

A pattern of brain activity that helps prevent us from getting lost has been identified in a new study, published in *Nature Human Behaviour*.

Researchers at the University of Birmingham and Ludwig Maximilian University of Munich have for the first time been able to pinpoint the location of an internal neural compass which the human brain uses to orientate itself in space and navigate through the environment.

The research identifies finely tuned head direction signals within the brain. The results are comparable to neural codes identified in rodents and have implications for understanding diseases such as Parkinson's and Alzheimer's, where navigation and orientation are often impaired.

Measuring neural activity in humans while they are moving is challenging as most technologies available require participants to remain as still as possible. In this study, the researchers overcame this challenge by using mobile EEG devices and motion capture.

First author Dr. Benjamin J. Griffiths said, "Keeping track of the direction you are heading in is pretty important. Even small errors in estimating where you are and which direction you are heading in can be disastrous. We know that animals such as birds, rats and bats have neural circuitry that keeps them on track, but we know surprisingly little about how the human brain manages this out and about in the real world."

A group of 52 healthy participants took part in a series of motion-tracking experiments while their brain activity was recorded via scalp EEG. These enabled the researchers to monitor brain signals from the participants as they moved their heads to orientate themselves to cues on different computer monitors.

In a separate study, the researchers monitored signals from 10 participants who were already undergoing intercranial electrode monitoring for conditions such as epilepsy.

All the tasks prompted participants to move their heads, or sometimes

just their eyes, and brain signals from these movements were recorded from EEG caps, which measure signals from the scalp, and the intracranial EEG (iEEG), which records data from the hippocampus and neighboring regions.

After accounting for 'confounds' in the EEG recordings from factors such as muscle movement or position of the participant within the environment, the researchers were able to show a finely tuned directional signal, which could be detected just before physical changes in head direction among participants.

Dr. Griffiths added, "Isolating these signals enables us to really focus on how the brain processes navigational information and how these signals work alongside other cues such as visual landmarks. Our approach has opened up new avenues for exploring these features, with implications for research into neurodegenerative diseases and even for improving navigational technologies in robotics and AI."

In future work, the researchers plan to apply their learning to investigate how the brain navigates through time, to find out if similar neuronal activity is responsible for memory.

More information: Electrophysiological signatures of veridical head direction in humans, *Nature Human Behaviour* (2024). DOI: 10.1038/s41562-024-01872-1

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