Medical Xpress

Researchers introduce enhanced brain signal analysis technique

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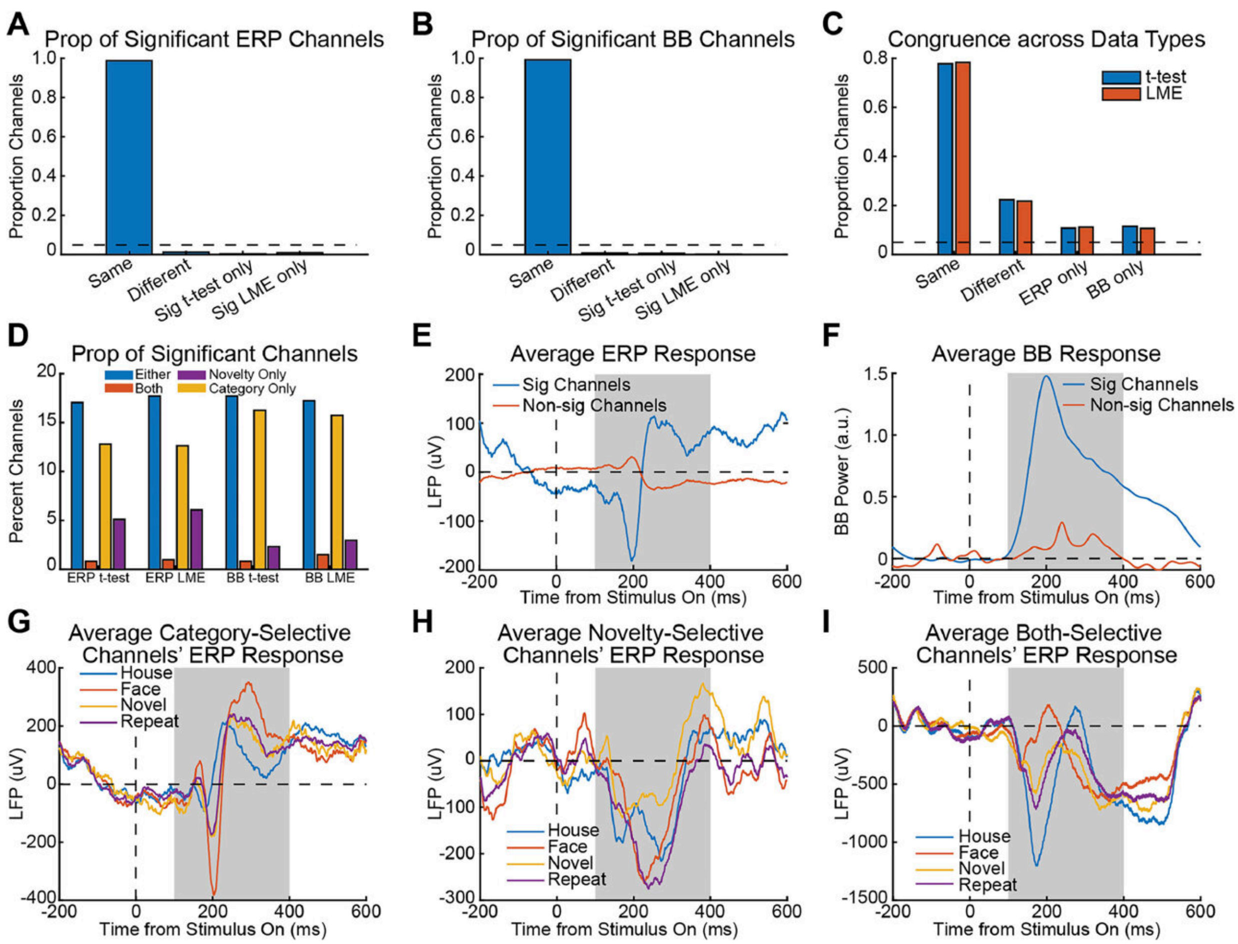

Replication of previous results using a predefined time window. (A) Proportion of channels whose ERP signals' significance were labeled the same or different by LMEs and separate t-tests. (B) Proportion of channels whose broadband (BB) power signals' significance was labeled the same or different by LMEs and separate t-tests. (C) Congruence of results across data types and statistical models. Congruence was lower across data types. (D) Percent of channels labeled as significant by data type and statistical model. (E) Averaged ERP responses for significant channels (blue) vs. non-significant channels (orange) showed biphasic responses as well as sustained activity after image onset. (F) Averaged broadband power responses for significant channels (blue) vs. non-significant channels (orange) showed good onset timing but missed sustained activity after image offset. (G) Averaged ERP responses for category-selective channels (n = 70) showed most category-selectivity occurred within the predefined time window. (H) Averaged ERP responses for novelty-selective channels (n = 26) showed sustained novelty-selectivity after image offset. (I) Averaged ERP responses for channels (n = 6) selective for both category and novelty showed more complicated responses with sustained activity after image offset. *Shaded regions indicate the predefined time window from 100 to 400 ms after image onset. Images disappeared at 400 ms. Credit: *NeuroImage* (2024). DOI: 10.1016/j.neuroimage.2024.120557

University of Minnesota Medical School researchers have introduced a new, refined method for analyzing brain signals, enhancing our understanding of brain functionality. This research has the potential to improve treatments for neurological conditions such as Parkinson's disease, pain, epilepsy and depression. The findings were recently published in *NeuroImage*.

"This breakthrough provides a more detailed understanding of the brain's complex activity, akin to upgrading from a basic telescope to a sophisticated space observatory," said David Darrow, MD, MPH, an assistant professor at the U of M Medical School, a neurosurgeon with M Health Fairview and senior author. "This innovation could impact various aspects of everyday life—from education and mental health to artificial intelligence, paving the way for future technological advancements and a deeper understanding of human cognition."

One of the key findings of this research is the enhanced ability to analyze direct brain recordings—meaning scientists can now better understand how brain activity correlates to different tasks and behaviors. Additionally, this method allows researchers to directly extract patterns of brain activity over time, revealing how different brain areas process stimuli during tasks such as image identification.

"This research represents a significant advance in our ability to analyze neural signals. It opens up new possibilities for understanding the complex dynamics of the human brain, paving the way for future discoveries in neuroscience," said Alexander Herman, MD, Ph.D., an assistant professor of psychiatry at the University of Minnesota Medical School, attending psychiatrist with M Health Fairview and co-senior author.

The research team is working on the next iteration of the platform, which will allow them to decode brain signals and apply strategies for integrating them into medical devices and new treatments.

More information: Seth D König et al, Flexible multi-step hypothesis testing of human ECoG data using cluster-based permutation tests with GLMEs, *NeuroImage* (2024). DOI: 10.1016/j.neuroimage.2024.120557

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