Study reveals shared blueprint in brain development across different functional areas

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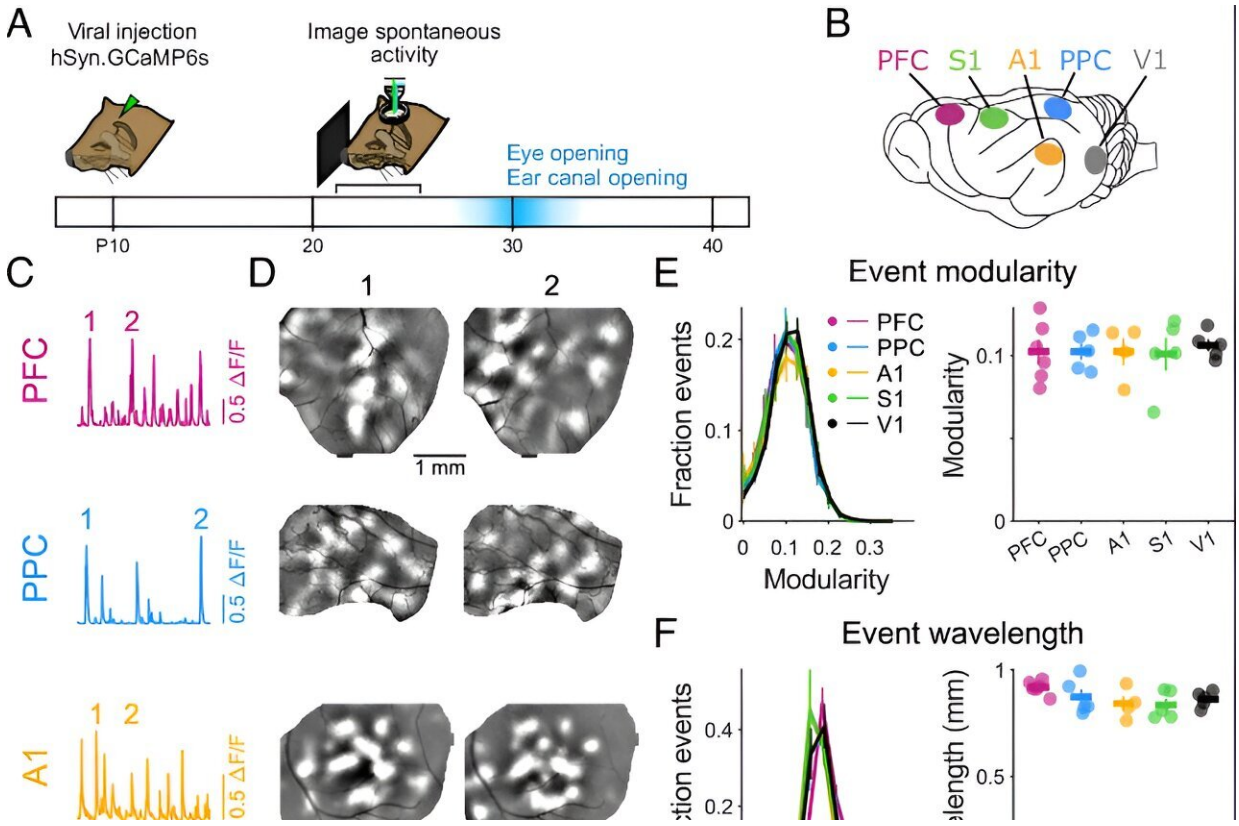

Spontaneous activity is highly modular in early development across diverse cortical areas. (A) Experimental schematic. Spontaneous activity was imaged at P21-24, 7 to 14 d prior to eye-opening and ear canal opening. (B) Activity was

imaged in primary somatosensory (S1), auditory (A1), and visual (V1) cortices, and in the association areas PFC and PPC. (C) Time course of spontaneous activity (mean activity across ROI) in each brain area imaged in independent experiments. (D) Individual spontaneous events (times indicated in C) show highly modular activity in all areas. (E) The modularity of spontaneous events does not vary across cortical areas. For panels (E–G): Left plot shows distribution across all events, Right plot shows median of distribution for each animal (dots) and mean across animals (horizontal bar). (F) The wavelength of activity for spontaneous events is similar across events from different areas. (G) Module amplitude (active module vs. adjacent cortex) is generally similar across areas, with significantly lower amplitude in S1 and higher amplitude in V1. Significant post hoc pairwise comparisons indicated by horizontal lines. Error bars ± SEM. Credit: *Proceedings of the National Academy of Sciences* (2024). DOI: 10.1073/pnas.2313743121

In a new study published in *Proceedings of the National Academy of Sciences*, researchers from the University of Minnesota Medical School have investigated brain development to understand how different areas of the brain become specialized in handling information such as vision, sound, touch and planning.

The study found that different areas of the brain start with a similar organization rather than already being specialized in early development. This suggests that the brain might use a single shared blueprint to guide early development.

"Throughout life, the brain continually builds on the foundations set earlier in development. This strong similarity in early development across very different areas of the brain suggests that neurodevelopmental disordersâ€"such as autism or schizophrenia, which affect many

different parts of the nervous systemâ€"may act similarly across these different brain areas," said Gordon Smith, Ph.D., assistant professor at the U of M Medical School and principal investigator on the study. Dr. Smith is also a member of the Medical Discovery Team on Optical Imaging and Brain Science.

In collaboration with the Frankfurt Institute of Advanced Studies, the research team used advanced optical imaging techniques to measure spontaneous activity in diverse brain areas. They found that even in different parts of the brainâ€"such as those responsible for hearing, seeing and feeling touchâ€"as well as in areas linked to thinking in both the front and back part of the brain, the activity in networks of brain cells showed a very similar organization during early development.

Researchers discovered that nerve cells in these areas work together in small, synchronized groups. These groups are part of bigger networks that cover millimeters in each part of the brain.

"This type of organization has long been a hallmark of visual brain areas, but finding it in other regionsâ€"especially in non-sensory regions like the prefrontal cortexâ€"was a surprise," said Dr. Smith.

Ongoing research will examine other brain regions at different stages of development to determine how the common blueprint identified in this study changes over time.

More information: Nathaniel J. Powell et al, Common modular architecture across diverse cortical areas in early development, *Proceedings of the National Academy of Sciences* (2024). DOI: 10.1073/pnas.2313743121