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Long memories in brain activity explain streaks in individual behaviour

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(Medical Xpress)—Even with a constant task, human performance fluctuates in time-scales from seconds to minutes in a fractal manner. In a recent study a Finnish research group found that the individual variability in the brain dynamics as indexed by the neuronal scaling laws predicted the individual behavioral variability and the conscious detection of very weak sensory stimuli. These data indicate that individual neuronal dynamics underlie the individual variability in human cognition and performance. Results may also have a strong impact in understanding the neuronal mechanism of neuropsychiatric diseases in which behavioral dynamics are abnormal.

Human performance in cognitive tasks varies from moment-to-moment so that the similar behavioral performance is clustered into streaks. The neuronal dynamics underlying this behavioral variability has remained unknown.

Similar scale-free and power-law distributed "avalanche dynamics" is observed in many natural systems such as sand piles, earthquakes, gene regulation, and also brain activity. However, the functional significance of the neuronal scale-free behavior has remained unknown. It is also unclear whether it is just epiphenomena without any further significance.

"We investigated whether the individual variability in the scaling-laws governing the detection of auditory and visual stimuli presented in the threshold of detection could be predicted by the variability in the

neuronal scaling laws," explains Matias Palva, project leader in the Neuroscience Center of the University of Helsinki, Finland.

The researchers used magneto- and electroencephalography to record non-invasively human brain activity during the task performance. They found that both the behavioral and neuronal dynamics were characterized by scale-free dynamics. Individual variability in the neuronal scaling laws predicted the individual scaling laws in behavioral performance.

"These results suggest that the individual behavioral and psychophysical variability in task performance is largely a result of the inherent variability in the individual neuronal dynamics," says project leader Satu Palva.

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