Examining the brain as a neural information super-highway

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An article demonstrating how tools for modeling traffic on the Internet and telephone systems can be used to study information flow in brain networks will be published in the open-access journal *PLoS Computational Biology* on 2nd June 2011.

The brain functions as a complex system of regions that must communicate with each other to enable everyday activities such as perception and cognition. This need for networked computation is a challenge common to multiple types of communication systems. Thus, important questions about how information is routed and emitted from individual brain regions may be addressed by drawing parallels with other well-known types of communication systems, such as the Internet.

The authors, from the Rotman Research Institute at Baycrest Centre, Toronto, Canada, showed that – similar to other communication networks – the timing pattern of information emission is highly indicative of information traffic flow through the network. In this study the output of information was sensitive to subtle differences between individual subjects, cognitive states and brain regions.

The researchers recorded electrical activity from the brain and used signal processing techniques to precisely determine exactly when units of information get emitted from different regions. They then showed that the times between successive departures are distributed according to a specific distribution. For instance, when research study participants were asked to open their eyes in order to allow visual input, emission times

became significantly more variable in parts of the brain responsible for visual processing, reflecting and indicating increased neural "traffic" through the underlying brain regions.

This method can be broadly applied in neuroscience and may potentially be used to study the effects of neural development and aging, as well as neurodegenerative disease, where traffic flow would be compromised by the loss of certain nodes or disintegration of pathways.

More information: Mišić B, Vakorin VA, Kovačević N, Paus T, McIntosh AR (2011) Extracting Message Inter-Departure Time Distributions from the Human Electroencephalogram. PLoS Comput Biol 7(6): e1002065. doi:10.1371/journal.pcbi.1002065