Breakdown of neural networks could help doctors track, better understand spread of Alzheimer's in brain

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(Medical Xpress)—Scientists at Washington University School of Medicine in St. Louis have taken one of the first detailed looks into how Alzheimer's disease disrupts coordination among several of the brain's networks. The results, reported in *The Journal of Neuroscience*, include some of the earliest assessments of Alzheimer's effects on networks that are active when the brain is at rest.

"Until now, most research into Alzheimer's effects on brain networks has either focused on the networks that become active during a mental task, or the default mode network, the primary network that activates when a person is daydreaming or letting the mind wander," says senior author Beau Ances, MD, assistant professor of neurology. "There are, however, a number of additional networks besides the default mode network that become active when the brain is idling and could tell us important things about Alzheimer's effects."
Ances and his colleagues analyzed brain scans of 559 subjects. Some of these subjects were cognitively normal, while others were in the early stages of very mild to mild Alzheimer's disease. Scientists found that all of the networks they studied eventually became impaired during the initial stages of Alzheimer's.

"Communications within and between networks are disrupted, but it doesn't happen all at once," Ances says. "There's even one network that has a momentary surge of improved connections before it starts

dropping again. That's the salience network, which helps you determine what in your environment you need to pay attention to."

Other networks studied by the researchers included:

- the dorsal attention network, which directs attention toward things in the environment that are salient;
- the control network, believed to be active in consciousness and decision-making; and
- the sensory-motor network, which integrates the brain's control of body movements with sensory feedback (e.g., did the finger that just moved strike the right piano key?).

Scientists also examined Alzheimer's effects on a brain networking property known as anti-correlations. Researchers identify networks by determining which brain areas frequently become active at the same time, but anti-correlated networks are noteworthy for the way their activities fluctuate: when one network is active, the other network is quiet. This ability to switch back-and-forth between networks is significantly diminished in participants with mild to moderate Alzheimer's disease.

The default mode network, previously identified as one of the first networks to be impaired by Alzheimer's, is a partner in two of the three pairs of anti-correlated networks scientist studied.

"While we can't prove this yet, one hypothesis is that as things go wrong in the processing of information in the default mode network, that mishandled data is passed on to other networks, where it creates additional problems," Ances says.

It's not practical to use these network breakdowns to clinically diagnose

Alzheimer's disease, Ances notes, but they may help track the development of the disease and aid efforts to better understand its spread through the brain.

Ances plans to look at other markers for Alzheimer's disease in the same subjects, such as levels in the cerebrospinal fluid of amyloid beta, a major component of Alzheimer's plaques.

More information: Brier MR, Thomas JB, Snyder AZ, Benziger TL, Zhang D, Raichle ME, Holtzman DM, Morris JC, Ances BM. Loss of intranetwork and internetwork resting state functional connections with Alzheimer's progression. *The Journal of Neuroscience*, June 27, 2012. DOI:10.1523/JNEUROSCI.5698-11.2012

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