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Scientific Currents

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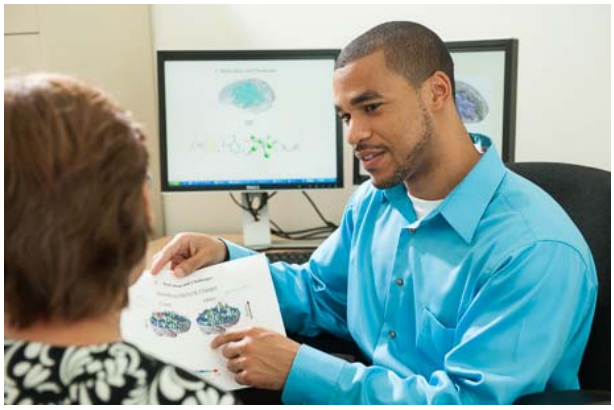
Brain Networking—Finding a Forest in the Trees



Dr. Sean Simpson, researcher in brain network science.

Dr. Sean Simpson, associate professor in the PHS Department of Biostatistical Sciences, is helping develop statistical methods to explain how regions of the brain communicate with each other and how the systemic properties of the resulting communication network relate to brain function. His recent efforts focus on comparing older and younger adults in order to better understand age-related cognitive decline.

Dr. Simpson's research falls under the umbrella of brain network science—an emerging field that seeks to understand the brain's communication network through the application of statistical models and other network science methods. Some questions it attempts to address include, "Can a model predict an individual's brain network based on phenotypic characteristics?" and "Can a statistical model quantify how much variability there is between one person's brain network and another's?"

Quantifying how much potential variability there is between different brain networks is critical for explaining and predicting true differences between groups—in the case of Dr. Simpson's current research, older and younger adults. These data will also produce more insight as to where in the brain these differences may occur.

The data being used to develop these models include scenarios with participants completely at rest, involved in visual tasks, and involved in multisensory tasks (visual and auditory). The variety of scenarios helps determine how communication systems change during different brain states. Once the data are compiled, a brain network is then constructed based on regions of the brain that are activating together during a given task. The assumption is that if the brain regions are activating together, then they must be communicating.

The development of statistical methods for brain network science has been lacking, mainly because of the complex nature of the data. However, brain network analysis holds great promise, from helping us better understand cognitive processes, to giving us information about different diseases (e.g., Alzheimer's and schizophrenia). If researchers can gain insight into the mechanistic causes of a disease, then the findings will inform more accurate diagnoses, better treatment options, and better prevention methods.