
End of the Spectrum

A Better Picture of Neurological Disease

As part of dyslexia study, Wake Forest University researchers develop a software program that integrates data from different imaging modalities.

As part of a project aimed at discovering the causes of dyslexia — a life-long, language-based learning disability that affects reading, writing, spelling, and speaking skills — Wake Forest University (WFU, Winston-Salem, North Carolina) Baptist Medical Center researchers are developing a multimodal software package they hope will shed light on the disease, which affects 10% of American children.

The development of the software package, which is being called a “statistical toolbox,” incorporates multiple imaging modalities, such as functional magnetic resonance imaging (fMRI), three-dimensional spectroscopy, positron emission tomography (PET), and diffusion imaging, marks the first part of the two-pronged project being funded by a four-year, \$2.3 million grant from the National Institutes of Health (NIH).

“I’ve been developing software tools for the processing of functional MR data for the last 10 years,” says Joseph A. Maldjian, an associate professor of radiology and director of the Advanced Neuroscience Imaging Research Laboratory at WFU, who also is serving as the project’s chief investigator. “There was a human brain project initiative from the NIH that was started a few years ago for the development of informatics and software tools that would help improve data processing, ways to make it more available for investigators, and advance techniques in brain imaging.

“The project has two components,” he continues. “There’s the informatics component and the biologic component. In the informatics component, we’re going to be developing software tools for multimodal image analysis. The idea is to take data from different imaging modalities and develop one statistical test to integrate it together.”

As part of the informatics phase, Maldjian and his associates have taken the decisive stand that imaging data will no longer mark the end, but rather the starting point of analysis.

The idea, he explains, is to do multiple imaging modalities in the subject population. For example, diffusion, functional, and spectroscopic imaging can be used on a specific region of the brain, and afterward, users can ask the software, “Where does the activation on the fMRI increase and metabolite increase in the same place?”

“With the various imaging modalities, data is usually just analyzed with respect to that image modality. So you do a functional MR experiment, and at the end of the study, you identify activation in a particular section of the brain and that’s the end point of the study,” Maldjian says. “Or if you use spectroscopic imaging, you identify metabolites inside the brain and then you might do a group study of different people with the same disease process, or you might identify that the metabolites in this specific area of the brain have either increased or decreased. And that’s usually the endpoint of that study.

“So now,” he continues, “you can formulate a more complicated hypothesis this way where the imaging data itself is driving the hypothesis.”

Maldjian predicts the software development phase of the project will take at least two years. In year three, the completed software will be distributed to various labs for testing and feedback. Afterward, the biologic component, in which the developed tools will be applied to dyslexia subjects, will occur. While Maldjian stresses the goal of the project is not to find a cure for dyslexia, he also doesn’t want to completely close the door on this being a future possibility.

“The project is about trying to understand the biologic basis of dyslexia in terms of what the underlying causes are, and also to find out if the various imaging modalities give us more information on what causes it,” he says. “It’s not really about finding a cure, although, down the line, if imaging is used to evaluate treatment regimens, then it’s possible.”

And while its initial foray is studying dyslexia, Maldjian theorizes the software package could one day also be used for examining other biologic disorders.

“The idea is to develop a software toolbox that can be used anytime you’re doing multiple imaging modalities for whatever you’re looking at,” Maldjian says. “It doesn’t have to be dyslexia. We chose dyslexia because there’s a strong tradition of dyslexia research here at Wake Forest University.” ■



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