

## Hear Jane read: Researcher gives new meaning to semantics

July 15 2014

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For years a key way of diagnosing dyslexia has been how well a person reads aloud. Similarly, the reading skills of adult readers also have been assessed by having them read words aloud. "The idea is that the more you read in English, the more you will encounter words that don't follow standard rules of pronunciation, so it's an index of reading exposure and, presumably, ability," explains researcher William W. Graves. But are you a better reader if you pronounce a word based on its meaning, or based on its spelling? Does it make a difference? And why? Those are the questions Graves is seeking to answer.

To begin to understand his research, read this sentence silently: "William W. Graves, associate professor, psychology, Rutgers University-Newark, is the lead author of 'Anatomy is strategy: Skilled reading differences associated with structural connectivity differences in the reading network,' published in the June 2014 issue of the journal *Brain and Language*."

Now read the sentence aloud. Do you pronounce the words based on their meaning, or based on their pronunciation? "There are different ways to be a good reader," explains Graves, who is trying to determine whether a reader's choice of word meaning vs. word sounds impacts how skilled a reader is, and if it does, why. His findings, as reported in *Brain and Language*, could have applications for developing learning programs for individual readers, or tailoring reading therapies for people with brain injuries, or adults struggling with reading who need to "re-learn how to read," explains Graves.

"There has been lots of discussion over the years about some readers having more of a sound-based style and others having more of a meaning-based style," he notes. "But there has been very little evidence of this, particularly evidence connecting brain behavior and reading behavior, until now."

Since the beginning of the decade, Graves has been examining the connections between the different areas of the brain involved in reading aloud. His initial research has used brain imaging to study good readers who benefit from word meanings derived from the spelling of the words. He has just begun his next phase: studying skilled readers who rely on the sound structure of words to determine meanings.

The final phase of his research—which is all funded by the National Institute of Child Health and Human development, a unit of the National Institutes of Health—will examine the impact of letter combinations, or orthography, which uses a different processing component of the brain, on how well adults read.

Previously, most behavioral and neuroimaging studies were focused on learning disabled, brain-damaged or new readers, and these provide clear evidence for individual differences related to reading skill and cognitive capacities, explains Graves. But only limited research addressed differences in adult "good readers," notes Graves.

This was the impetus for Graves' research, begun with five other investigators while he was at the Medical College of Wisconsin. The team studied 18 adults classified as good readers to determine whether college-educated, proficient readers differ in how they use word meanings when they read aloud. Each volunteer made one visit to a functional magnetic resonance imager (fMRI) where multiple scans were taken as the volunteer read aloud from lists rich in highly "imageable" words—words that readily evoke mental images—which are easier to

measure than less vivid words.

The next step in Graves' research was to determine whether the brain responded differently, and in a measurable way, to the words that evoke mental images, as opposed to those that don't, while reading aloud.

Would brain scans show a correlation between those vivid word images and anatomical differences in the brain circuits that relate word meanings to pronunciation?

For this part of the study, each of the volunteers underwent a scan called Diffusion Tensor Imaging, which maps the white matter connections in the brain. White matter, explains Graves, is like the insulation on copper wires that help the wire to better conduct electricity; white matter insulates the nerve fibers in the brain, helping them to better transmit signals within the brain.

"We knew from a previous study that reading image-rich words stimulates certain areas of the brain—areas involved in computing word meanings," says Graves. The [white matter](#) scans showed increased physical connectivity between several regions of the brain, including those for processing word meanings (like the angular gyrus and posterior cingulate/precuneus) and those for processing word sounds (like the [superior temporal gyrus](#)).

However, he notes, "You don't have to process a word's meaning to read it aloud." The more important finding, Graves says, is that there are different styles of reading. This varies even among good readers, and corresponds to differences in thickness of connections between [brain](#) areas that process word sounds (phonology) and word meanings (semantics).

**More information:** [www.sciencedirect.com/science/.../S0093934X14000431](http://www.sciencedirect.com/science/.../S0093934X14000431)

Provided by Rutgers University

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