# Brain processing of speech sounds is different in some Southern English speakers

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When Rice University alumna Brianna Conrey was in third grade in Stillwater, Okla., she misspelled "pen" on a test because her teacher unknowingly pronounced it "pin." At the time, Conrey never would have guessed that she would write a senior thesis in college about the brain activity that takes place in people who don't distinguish between similar-sounding words like "pin" and "pen." Nor would she have guessed that her thesis would get published several years later in the journal Brain and Language.

While working on a B.A. in linguistics at Rice, Conrey wanted to study the variation in spoken American English in certain regions of the U.S. "I lived in a lot of different areas of the country as a kid and was exposed to many different ways of talking, so this topic was really fascinating," Conrey said. "We know from sociolinguistics - the study of language variation and change - that a great deal of phonetic variation occurs even within a single language."

She cited as an example a language variation known as a "vowel merger," in which two vowels with different pronunciation in one dialect of a language are merged, or not distinguished in pronunciation, in another dialect. The pin/pen merger, in which "i" and "e" are both pronounced like "i" before nasal sounds like "n" and "m" but not in other contexts, is often heard in Southern states and Texas, where a merged-dialect speaker might sound like they're pronouncing both "pin" and "pen" as "pin" to an unmerged-dialect speaker. The merged-dialect speaker is unlikely to be aware of the lack of distinction between the two sounds.

"Our study was interested in figuring out what happens in the brain when people who speak these different dialects hear similar sounds pronounced," said Conrey, who received funding from the Rice University Undergraduate Scholars Program. She consulted with Rice's Nancy Niedzielski and Geoffrey Potts on how to do the research for her honors thesis. Niedzielski is an assistant professor of linguistics, and Potts is an assistant professor of psychology.

Taking advantage of cognitive neuroscience tools available in Potts' lab, Conrey was able to monitor patterns of brain activity in merged-dialect and unmerged-dialect speakers.

Electrodes placed on the heads of 23 student volunteers recorded the electrical activity in the parietal lobes of their brains when the students viewed a phrase on a computer screen, listened to a word through headphones and then indicated whether the pronounced word matched the word on the computer. For example, the computer would show "Sign the check with a" and then "pen" by itself, and then the volunteer would hear "pin" or "pen" via headphones and have to touch a keypad to indicate whether the spoken word was the same as or different from the single word that flashed on the computer. Half of the spoken words matched the unmerged-dialect pronunciation of the word on the screen, and the other half matched the merged-dialect pronunciation but not the unmerged-dialect.

Conrey had applicants for the study read a paragraph to determine whether they had a merged dialect so she could balance the types of students participating in the study.

"Our results indicated significant behavioral and physiological differences between a merged- and an unmerged-dialect group in evaluating congruity between auditory and visual presentations of words containing vowels that are merging in pronunciation in the merged

dialect," Conrey said. The merged-dialect group identified incongruent merger pin/pen stimuli as congruent 59 percent of the time, but the unmerged-dialect group did so only 22 percent of the time. The unmerged-dialect group's failure to get a lower error rate might be due to their exposure to the merger in other dialects, she noted.

The level of brain activity recorded by the electrodes was significantly higher in the unmerged-dialect group. This difference suggests that the merged- and unmerged-dialect groups processed the pin/pen acoustic stimuli differently at a conscious, decisional level that required explicit memory for the previously presented visual stimulus. "The unmerged-dialect group was able to act on discrepancies between the incongruent pin/pen templates and auditory words, but the merged-dialect group was unable to make a distinction between incongruent pin/pen templates and auditory words at a conscious or decisional level," Conrey said.

"The speakers Brianna used for her study have no reason to distinguish between 'pin' and 'pen,' either from a perception or production standpoint, since others in their speech community don't," Niedzielski said. "It's just a matter of what the speakers have been exposed to and the distinctions they're used to making."

Potts noted that previous studies have shown that the Japanese, whose language does not distinguish between the "l" and "r" sounds, will have the same brain response when hearing native English speakers use the "l" and "r" phonemes. "But Brianna's study was the first to show the same effect in dialects of the same language," he said.

After Conrey finished her thesis and graduated from Rice in 2002, she continued her research in Potts' lab to acquire more data for the study and then submitted the paper to the journal Brain and Language, which published it last August.

"The methods used for this study allowed us to begin investigating the component neural processes involved in the differential behavior of speakers of two dialects of the same language," said Conrey, who is now a graduate student at Indiana University in Bloomington.

Source: Rice University