

# Neurological basis for embarrassment described

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Recording people belting out an old Motown tune and then asking them to listen to their own singing without the accompanying music seems like an unusually cruel form of punishment. But for a team of scientists at the University of California, San Francisco and University of California, Berkeley, this exact Karaoke experiment has revealed what part of the brain is essential for embarrassment.

The twist to the experiment was that most of the subjects had [neurodegenerative diseases](#), which helped scientists identify a thumb-sized bit of tissue in the right hemisphere of the front part of the [brain](#) called the "pregenual [anterior cingulate cortex](#)" as integral to [embarrassment](#).

The degree to which the singers were embarrassed in hearing themselves sing "My Girl" – the 1964 hit by the Temptations – depended on the integrity of this particular region.

"In healthy people, watching themselves sing elicits a considerable embarrassment reaction," said Virginia Sturm, a postdoctoral fellow at UCSF. Their blood pressure goes up, their heart rate increases, and their breathing changes, she explained. People who had neurological damage in the medial frontal cortex, however, responded more indifferently.

"This brain region predicted the behavior," said Sturm. "The smaller the region, the less embarrassed the people were."

Knowing that people lose their ability to be embarrassed and which part of the brain governs that ability may suggest ways to help diagnose people with certain neurodegenerative diseases earlier.

The work, presented today at the 63rd Annual Meeting of the American Academy of Neurology in Hawaii, is part of a larger body of work at UCSF's Memory and Aging Center examining emotion and social behavior in neurodegenerative diseases and searching for better ways to predict, prevent and treat them.

## **How Neurodegeneration Changes Behavior**

Neurologists at UCSF and elsewhere in the country have documented for years how people with a group of related neurodegenerative conditions called frontotemporal dementia act in ways that would be embarrassing to healthy people. These conditions result from progressive degeneration of the temporal and frontal lobes of the brain, which play a significant role in decision-making, behavior, and understanding and expression of emotion and language – including complex emotions like embarrassment.

As these parts of the brain deteriorate, people lose their ability to interact with others and may behave strangely. A growing body of work at UCSF and other medical centers has linked the loss of certain brain structures and neuronal networks to specific behavioral changes.

In their Karaoke experiment, Sturm and her colleagues took 79 people – most with neurodegenerative diseases – and asked them to sing while probes measured their vital signs and cameras videotaped their expressions.

They sang. Their songs were recorded, and then they were played back at normal speed without the accompanying music. Sturm and her

colleagues assessed how embarrassing this was for the participants based on facial expressions and physiological markers, such as sweating and heart rate.

Next, all the people sat for MRIs, which made extremely accurate maps of their brains. Sturm and her colleagues used these maps to measure the volumes of the different regions of the brain and considered whether the sizes of those regions could predict embarrassment.

They found that people who had significant neurodegeneration in the pregenual anterior cingulate cortex were less likely to be embarrassed. In fact, the more deterioration of tissue this part of the brain, the less embarrassed people were about their own singing.

The same group was also subjected to a simple "startle" test of emotional reactivity in which they sat quietly until a loud gunshot sound crashed through the room.

"They do jump, and they are afraid," said Sturm, "so it's not like they don't have any emotional reactions at all. But patients with loss in this brain region seem to lose these more complicated social emotions. Emotions like embarrassment are particularly vulnerable in neurodegenerative diseases that target the frontal lobes."

While changes in thinking and memory are easily identified by family members and clinicians, changes in emotion and social behavior can be more subtle and easily missed. A better understanding of the neural basis of social emotions like embarrassment may also help family members and caregivers better comprehend their loved ones' more severe behavioral changes.

Provided by University of California, San Francisco

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