Researchers find unanticipated complexity in aging brain's memory decline

March 18 2024, by Stephen Fontenot

Sabina Srokova Ph.D. and Dr. Michael Rugg, director of the Center for Vital Longevity. Credit: University of Texas at Dallas

Researchers from The University of Texas at Dallas Center for Vital Longevity (CVL) have discovered that brain correlates of age-related

memory decline are more complicated than previously believed, a finding that could affect efforts to preserve cognitive health in older people.

Dr. Michael Rugg, CVL director and professor of psychology in the School of Behavioral and Brain Sciences, is the senior author of a study, published in *The Journal of Neuroscience,* that found that age-related neural dedifferentiation, marked by a decline in the functional specialization of different brain regions, is driven by multiple mechanisms.

As people age—even in good health—the brain becomes less precise in how different classes of visual information are represented in the visual cortex. This reduction in neural selectivity, or dedifferentiation, is linked to worsening memory performance.

Using functional MRI (fMRI), the researchers examined the brain activity patterns of participants as they viewed images that belonged to broad categories of panoramic scenes and objects. Some of the images were repeated, thus allowing measurement of the brain's activity patterns elicited by image categories as well as by individual stimulus items.

The participants included groups of healthy young and older adults—24 men and women with an average age of 22 years and 24 with an average age of 69 years.

"At the category level, as we expected, we found that the older group showed reduced selectivity for scenes compared to the younger group, but not for objects," Rugg said. "But when we looked at individual items, selectivity for both scenes and objects was reduced in the older group. This implies that the mechanisms driving dedifferentiation at the single-item level are not the same as those at the category level. We had, to this point, assumed they were one and the same mechanism."

The implication, Rugg said, is that knowing how selective an individual's brain is for categories does not predict how selective the brain will be for individual items.

"There isn't a one-size-fits-all theory of age-related neural dedifferentiation," said Rugg, who is also the Distinguished Chair in Behavioral and Brain Sciences.

"This has important implications for how we understand and investigate age differences in neural selectivity, some measures of which are predictive of memory performance. Moving forward, we're going to have to be more cautious in how we generalize from category-level findings to what's happening more broadly in the brain as people grow older."

Corresponding author Sabina Srokova, Ph.D.'22, a former student of Rugg's who is now a research associate at the University of Arizona, said the findings suggest at least two independent factors drive the reduction in selectivity in older adults.

"We know that the neural mechanisms underlying category-level selectivity are robustly related to memory success across the adult lifespan," Srokova said. "However, the factors that contribute to the relationship between neural selectivity, age, and memory abilities remain unknown."

"Now that we believe different neural mechanisms are at work in these two contexts, it's crucial that we continue to study them separately."

Researchers will next examine the mechanisms that contribute to age-related declines in category-level selectivity using simultaneous recording of eye movements during fMRI scanning.

More information: Sabina Srokova et al, Dissociative Effects of Age on Neural Differentiation at the Category and Item Levels, *The Journal of Neuroscience* (2023). DOI: 10.1523/JNEUROSCI.0959-23.2023