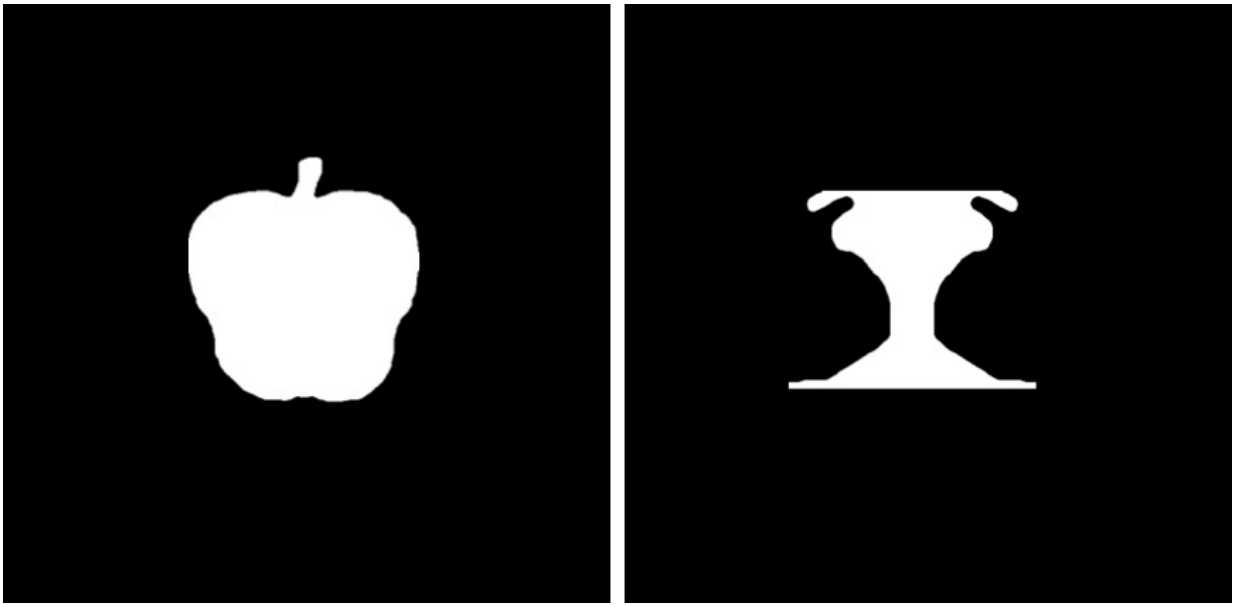
Research shows how visual perception slows with age

June 21 2016, by Alexis Blue



The image on the left depicts a familiar object -- an apple --- while the one on the right shows a novel object that doesn't suggest anything familiar on the outside of the left and right borders. Credit: University of Arizona

Grandparents may be some of the best storytellers around, in the sense that they usually have plenty of stories to tell. What they're not always as good at, however, is staying on topic when they regale others with their tales.

Indeed, what might begin as an account about their snowy trek to school

could easily go off on tangents about the time they visited the Grand Canyon or their granddaughter's recent soccer game.

Staying on topic may be more difficult for older adults than it is for younger people because older adults begin to experience a decline in what is known as inhibition—the ability to inhibit other thoughts in order to pursue the storyline.

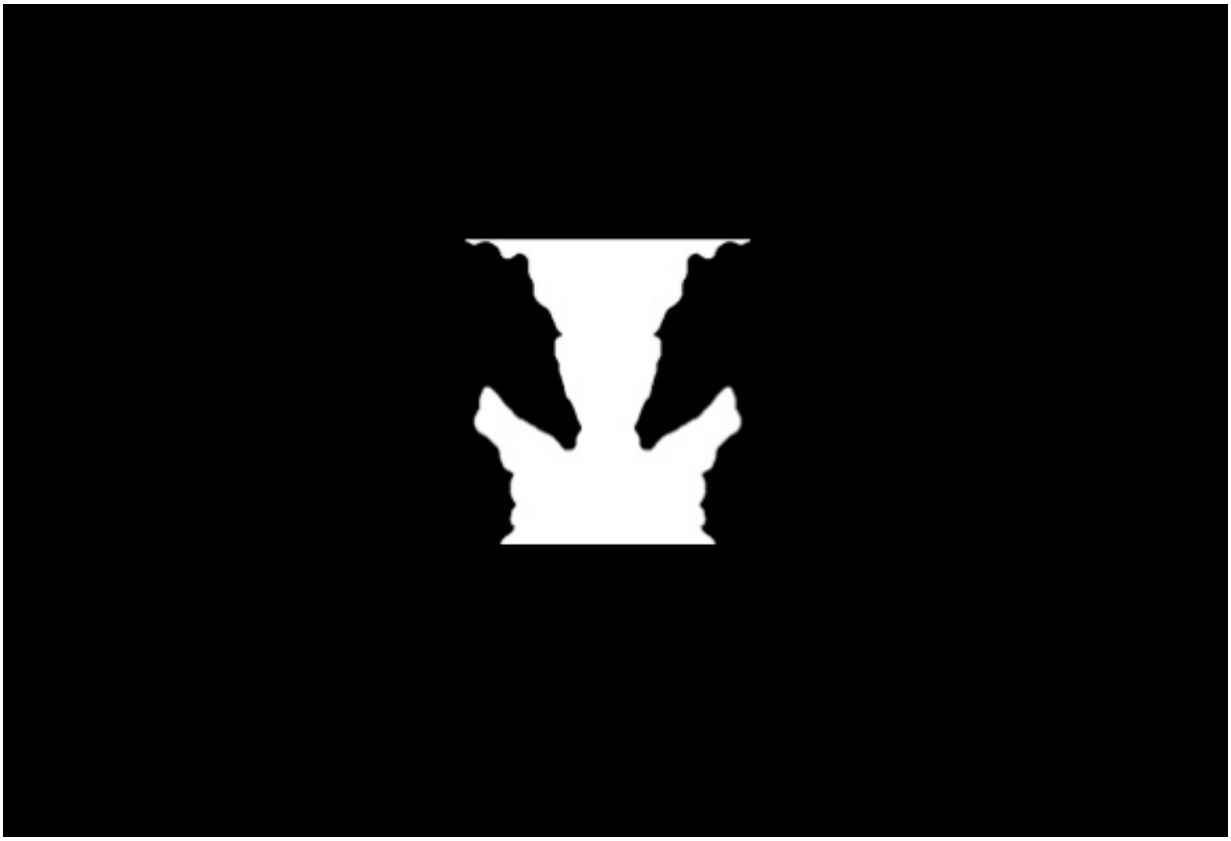
Evidence for inhibition deficits in older adults has appeared in studies that task participants with completing a familiar phrase with an unfamiliar word. For example, when asked to complete out loud the sentence "I take my coffee milk and ..." with the word "pajamas" instead of "sugar," older adults are more likely to first respond with "sugar" than young participants because they have a harder time inhibiting the high-probability word to complete the sentence.

Decline in inhibition also can affect visual perception, as is demonstrated by new research, involving the University of Arizona, that is adding to science's understanding of how vision changes with age.

Inhibition is an important part of neural processing throughout the brain, and it plays a significant role in visual perception. For example, evidence suggests that when we look at an object or a scene, our brain unconsciously considers alternative possibilities. These competing alternatives inhibit one another, with the brain effectively weeding out the competition before perceiving what is there, says Mary Peterson, professor of psychology and director of the Cognitive Science Program in the UA Department of Psychology.

With regard to vision, age-related declines in the efficiency of inhibitory processes have been demonstrated in research involving simple perception tasks, such as the ability to detect symmetry and discriminate between shapes.

Peterson and her collaborators set out to see if the same deficits are evident when it comes to more complicated visual tasks. Their findings, published in the *Journal of Vision*, suggest that they are.



A silhouette of a novel object that suggests portions of two seahorses on the outside of the left and right borders presents a high inhibitory competition condition. Credit: University of Arizona

Peterson and her fellow researchers—lead author John A.E. Anderson at York University in Toronto, M. Karl Healey at the University of Pennsylvania and Lynn Hasher at the University of Toronto—were interested specifically in what is known as figure-ground perception, in

which two areas in a person's visual field share a border. If you imagine a white heart on a black background, for example, the heart is the "figure"—with its definitive shape—and the black background is the "ground," which seems to simply continue behind the figure.

In the lab, researchers showed on a screen a series of small, symmetrical white-on-black silhouettes, created by Peterson and her UA students, to two different groups: young participants with an average age of about 20 and older participants with an average age of about 66. Participants were asked to determine whether each white "figure" depicted a familiar object, such as an apple, or a novel object—a meaningless shape.

Of the novel-object images presented, half showed a meaningless white "figure" against a black "ground" but included a border between black and white that could suggest a meaningful object in the black portion of the image. For example, the border of one meaningless white shape suggested the outline of two seahorses in the black area. This kind of complex image requires that substantial inhibitory competition take place in the brain before an object is perceived.

"For a long time my students and I have been investigating how we see the world. Our work has suggested that the brain first detects all the borders in a scene and then for every border, accesses object properties—essentially different interpretations—on both sides," Peterson said. "These two interpretations compete by inhibiting each other, and whichever one has more evidence in favor of it is going to exert more inhibition on the other one to win the competition."

In the end, younger and older participants both came to the same conclusions about whether the white objects were familiar. However, it took longer overall for older adults to come to that conclusion, especially when images presented more inhibitory competition. The findings support and further evidence that older adults experience age-related

deficits in inhibition related to vision.

"This is particularly interesting as it suggests that distraction is being processed extremely rapidly, and without conscious awareness, but that older adults are less able to tolerate this ambiguity than younger adults," said Anderson of York University. "This research may have practical importance for how perception changes with age as well, particularly in situations of low visibility—possibly fog, bad lighting, et cetera—when the identity of shapes is harder to discern."

The researchers believe that age-related inhibitory deficits are due to reduced functioning of GABA neurotransmitters in the brain, which are thought to mediate inhibition. However, more research is needed to be certain, Peterson said.

"There is going to be more or less competition in some of the scenes you look at over the course of the day," Peterson said, "so the prediction is that when there is high competition, older adults will take longer to resolve—to see—the objects in that scene."

More information: John A. E. Anderson et al. Age-related deficits in inhibition in figure-ground assignment, *Journal of Vision* (2016). DOI: 10.1167/16.7.6

Provided by University of Arizona

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