You may have heard the saying "You can't teach an old dog new tricks." In neuroscience, the equivalent sentiment used to be "You can't teach an old brain new tricks." As the owner of an older dog and as a modern neuroscientist, I know that both sayings are incorrect. I taught Archie, my 11-year-old border terrier, a new trick just the other day. Furthermore, research in our lab and in others around the world has shown that older brains are not as fixed and inflexible as they were once thought to be.

For example, our research group compared the performance of younger and older adults on a basic visual memory task in which observers simply had to look at two sets of bars and tell us which set contained the thicker bars. Sometimes the bars were shown one right after another, and other times the size of the first set of bars had to be remembered for several seconds before the second set of bars appeared. When we looked at the behavioral results, we saw no difference in performance between younger and older participants.

When we used positron emission tomography scans to measure brain activity while people were performing this simple memory task, however, we saw a glimpse of the flexibility of older brains. The older adults seemed to be using different parts of their brains to do the task than did the younger participants. The older brains seemed to have rewired themselves to compensate for weaknesses that had developed in the brain network used in earlier years. To help perform the basic visual task well, older brains seemed to be recruiting parts of the hippocampus and prefrontal cortex -- those are parts of the brain that, in younger people, are thought to help with other cognitive skills, such as memory and attention.

In the case of the simple memory task we studied, this sort of compensatory reorganization of the brain was enough to ensure that performance levels remained constant across the life course. In other tasks, by contrast, we see clear differences in performance levels between younger and older adults. To investigate this phenomenon, my colleagues and I examined the effects of aging on the effective field of view. We built on work done in the 1980s by my father, Robert Sekuler, and his former student, Karlene Ball.

Measuring Divided Attention

In our test, observers were asked to name a letter that was presented briefly at the point of fixation, or to localize a spot that was flashed briefly in the peripheral visual field, or to do both of those tasks at the same time. The last exercise measures observers' ability to divide attention, and we were particularly interested in how this ability might change over the life course. We found that people's ability to divide attention declined decade by decade in a highly systematic way. For all observers,
dividing attention dimmed the effective field of view (the region of space observers could perceive in a single glance). The effective field of view was most dimmed for older observers.

This result has particularly important ramifications for performance in real-world activities. Karlene Ball, Cynthia Owsley and their colleagues have shown that performance on experiments like the one we conducted can predict the driving ability of older adults in certain situations. This link makes sense when one considers the multitasking demands of driving. If older adults are less able than younger people to divide attention among multiple tasks at the same time, it is reasonable to expect that driving ability could be relatively impaired in older adults.

Indeed, the deficit we see in such multitasking may be directly linked to the visual memory performance we saw in our brain-imaging experiment. It may be that in trying to compensate for problems in basic visual and sensory processing, the older brain borrows resources from areas of the brain usually used for higher-level cognitive processing such as complex memory and attention tasks. As long as one doesn't encounter challenging situations where memory and attention are required, task performance will appear normal. However, when one needs to use those areas of the brain for dividing attention in addition to basic sensory processing, the resources may be too limited, and performance on the attention task may suffer.

To what extent can we train older brains to overcome these sorts of limitations? We used the effective-field-of-view test to determine whether training would increase observers' ability to multitask, and whether learning to multitask occurred equally well for older and younger observers. The answer to both questions was a resounding yes. Because of the close link between performance on the effective-field-of-view task and driving, this sort of result raises the possibility that training in a basic multitasking situation may provide generalized skills to other areas. Indeed, this hypothesis is currently being investigated by several laboratories around the world; although much work remains to be done, the preliminary results seem promising.

Obviously, though, we still have many questions to answer about learning and the older brain. Under what conditions do we see generalization from a simple learning situation to more complex, real-world situations? What are the limits of learning? How does the brain change as a function of learning? When does training on one task make people perform better or worse on other tasks? This is an exciting time in the study of vision, aging and learning because our knowledge is advancing rapidly, but we still have so much to learn. One thing we do know is this: You can teach an older brain new tricks.

Allison Sekuler is professor and Canada Research Chair in Cognitive Neuroscience in the Department of Psychology, Neuroscience and Behaviour at McMaster University in Hamilton, Ontario, Canada. Her research focuses on how the brain processes visual information; she is particularly interested in how aging affects neural function.