People with less memory loss in old age gain more knowledge

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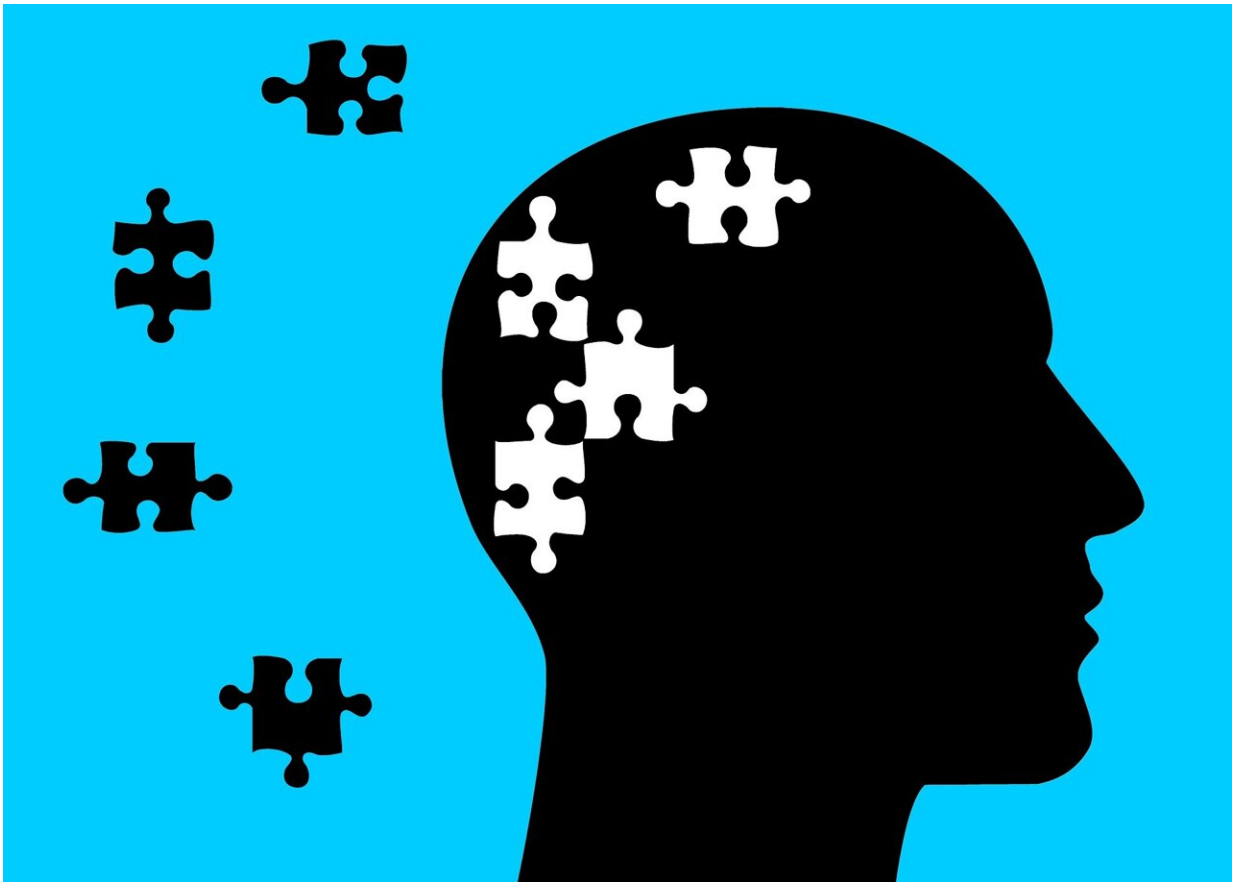

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Do cognitive abilities change together, or do they change independently of each other? An international research team from the USA, Sweden,

and Germany involving the Max Planck Institute for Human Development has presented new findings now published in *Science Advances*.

At the age of 20, people usually find it easier to learn something new than at the age of 70. People aged 70, however, typically know more about the world than those aged 20. In lifespan psychology this is known as the difference between "fluid" and "crystallized" cognitive abilities. Fluid abilities primarily capture individual differences in brain integrity at the time of measurement, whereas crystallized abilities primarily capture individual differences in accumulated knowledge.

Accordingly, fluid and crystallized abilities differ in their average age trajectories. Fluid abilities like memory already start to decline in middle adulthood. In contrast. crystallized abilities such as vocabulary show increases until later adulthood and only evince decline in advanced old age.

This divergence in the average trajectories of fluid and crystallized abilities has led to the assumption that people can compensate for fluid losses with crystallized gains. For instance, if an individual's memory declines, this loss, it is assumed, can be compensated for by an increase in knowledge.

A study of a research team from Germany, Sweden and the USA now shows that this compensation hypothesis has more limits than previously claimed. The researchers analyzed data from two longitudinal studies, the Virginia Cognitive Aging Project (VCAP) study from the USA and the Betula study from Sweden. In the VCAP study, 3633 female and 1933 male participants aged 18–99 years at the first occasion of measurement were followed for a period of up to 18 years and assessed up to eight times. The Betula study involved 1803 women and 1517 men who were between 25 and 95 years old at the first measurement occasion

and examined up to four times over 18 years.

The research team used multivariate methods of change measurement to examine the extent to which individual differences in changes in crystallized abilities are related to individual differences in fluid changes. The findings are clear: The correlations between the two types of changes observed in both studies were very high. Thus, individual differences in cognitive development are, to a large extent, domain-general and do not follow the fluid-crystallized divide. What this means is that individuals who show greater losses in fluid abilities simultaneously show smaller gains in crystallized abilities, and persons whose fluid abilities hardly decline show large gains in crystallized abilities.

These findings are in accordance with the everyday observation that some people remain mentally fit in many areas into very old age while others' cognitive functioning declines across the board.

"In intelligence research, people often talk about a general factor or g-factor of intelligence that expresses the commonality of different cognitive abilities," says the lead author of the study, Elliot Tucker-Drob of the Department of Psychology and the Population Research Center at the University of Texas at Austin, USA. "In previous work, we have already demonstrated that not only individual differences in cognitive abilities at a given point in time can be captured by a general factor, but also changes of cognitive abilities. Our new results confirm this finding and demonstrate that changes in crystallized abilities can indeed be subsumed under a general factor of common change."

"Our findings call for a revision of textbook knowledge," adds Ulman Lindenberger, Director of the Center for Lifespan Psychology at the Max Planck Institute for Human Development in Berlin. "If those who show the largest fluid losses also show the smallest crystallized gains,

then this places tighter limits on the compensatory power of knowledge than previously believed." For example, people whose memory is declining, also show a low gain in knowledge, even though they are in most need of such gains. Conversely, individuals with small fluid losses and strong crystallized gains are less likely to be in need of relying on compensatory processes to begin with.

Overall, the results underscore the great importance of identifying and supporting modifiable influences that contribute to the general maintenance of cognitive abilities in later adulthood and old age. An example is physical exercise that can prevent cardiovascular diseases and thereby help to maintain cognitive abilities.

More information: Elliot M. Tucker-Drob et al, A strong dependency between changes in fluid and crystallized abilities in human cognitive aging, *Science Advances* (2022). DOI: 10.1126/sciadv.abj2422

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