

New data indicate that some of the mental declines that accompany aging aren't as bad as researchers once thought. And in many cognitive domains, the old have a lot to teach the young

The Wisdom of the Wized

The study of how the mind changes with age can be pretty grim. Classic performance tests show similar trajectories across the lifespan: Movement speed, visual acuity, and several types of memory steadily and inexorably decline, starting as early as in one's 20s. People who behaved foolishly during their sophomore year of college would rightly be chagrined to learn that they were then at their peak mental performance.

But in the past few years, researchers have developed a much more optimistic view of the aging mind. They're motivated,

When cognitive abilities are divided into those that build on existing knowledge and those that require new learning, clear differences emerge between youngsters and oldsters. With advanced age, it takes longer to pick up new skills. Although this message may be frustrating to a 60-year-old trying to program the darn VCR, it means that people retain or even improve their performance in domains they practice regularly—that is, in the skills they care about most.

Older people outperform the whippersnappers in some spheres. For instance, el-

show that the aging brain doesn't lose as many neurons as was once thought, and that adult brains continue to sprout new neurons (*Science*, 3 January, p. 32). Researchers have adopted a "much more hopeful, positive view than 5 or 10 years ago," says Molly Wagster, program director for neuropsychology of aging research at the National Institute on Aging (NIA) in Bethesda, Maryland.

One of the great comforts of age is that the old are generally happier than the young are. They're in better mental health, they navigate interpersonal relationships more adeptly, and they suffer fewer negative emotions. Much cognitive aging research is motivated by a desire to find ways to help old people overcome cognitive failings, but regarding overall well-being, "we may do very well to study older people to see how to help younger people," says Carstensen.

The mismeasure of the mind

To isolate the effects of age, researchers try to make as clean a comparison as possible between subjects of different ages. Volunteers come to the same lab and take the same sets of tests, for instance. But the optimum testing conditions are not the same for all generations.

Most labs gather data in the afternoon, a convenient time for researchers and undergrad volunteers. But about 75% of the old are morning people; that's when they perform best. This is not true of college-age controls, who are generally sharper in the afternoon. Lynn Hasher of the University of Toronto and her colleagues started testing 20-somethings at 4 or 5 p.m. and 60- or 70-somethings at 8 or 9 a.m. Age differences in performance on basic memory tests, such as recognizing sentences from a story or memorizing a list of words, were cut in half.

Participating in a memory experiment can be more intimidating for old than young subjects. For example, young subjects learn a list of words better if researchers warn them in advance, rather than if they spring an unannounced recall test at the end of a session. For old people, the reverse is true, Hasher has found.

Researchers have a theory about this, explains psychologist Thomas Hess of North Carolina State University in Raleigh. Older people are acutely aware of age-related



Expertise. Old people maintain peak performance in skills they practice regularly.

in part, by the observation that most older people fare well in the world—living independently, contributing to family members' lives, and solving crossword puzzles into their 80s and beyond. "The physiological and cognitive declines measured in the lab don't map perfectly or even arguably well onto everyday life," says psychologist Laura Carstensen of Stanford University.

Some of this revisionism comes straight from a reexamination of lab testing conditions. Many skills improve with age, it turns out, but they aren't picked up by standard cognitive screens. And certain testing conditions have exaggerated age-related declines in performance.

Older people have better social wisdom: They can evaluate a stranger's personality more accurately. They also have better verbal abilities.

This isn't to deny that skills fade: Some important ones decline steeply, reliably, and almost universally (see *Science of Aging Knowledge Environment* article at sageke.sciencemag.org/cgi/content/full/sageke;2003/8/ns3). But researchers have found ways to improve older peoples' memory and mental abilities. Long-term studies of cognitive training regimens show that even prototypical age-sensitive tasks, such as quickly judging whether two complex figures are the same or different, improve with practice. The neuroanatomical news isn't so bleak, either: Recent studies

declines in memory. Explicitly describing something as a memory test heightens older subjects' anxiety and makes them anticipate that they'll perform poorly. Given standard testing conditions, which usually involve explicitly asking volunteers to participate in a study of memory and aging, "we may bias ourselves toward finding greater negative effects," says Hess.

To look for bias, Hess and his colleagues tinkered with older subjects' expectations about their memory performance. Volunteers read one of two mock newspaper articles at the beginning of a testing session. One described the declines in memory that accompany aging, whereas another article emphasized research on the preservation of memory skills over the lifetime. As the team reported in January in the *Journal of Gerontology*, those who read a pessimistic account of memory and aging remembered 20% to 30% fewer words than did people who learned about the joys of aging. (If your memory feels particularly sharp later today, thank *Science*.)

Social Solomons

With experience, most people become wise to the ways of the world. Older people are particularly well attuned to judging character, for instance. Given a list of behaviors of some fictional person, older people overlook distracting but relatively unimportant actions and focus on those that are more diagnostic, Hess has found. Old subjects are more likely than young ones to accurately label a stranger as dishonest or intelligent, for instance. "Older people have become experts in the social domain," he says.

A keen awareness of character can even compensate for pervasive memory disruptions, Hasher and her team reported in the March 2002 issue of *Psychological Science*. It can help connect words to their source, for example. Researchers call the ability to remember where you learned something "source memory." Failures of source memory, which increase dramatically with age, can be quite awkward; for instance, an elderly person may forget who told a joke and retell it to the source.

To probe this frailty, testers often ask people to listen to a series of statements spoken by either a male or female voice. At the end, subjects read the statements and say which voice spoke them. Hasher and her colleagues

added a twist: Before playing the tape, researchers told some subjects that one voice belonged to a saintly person who never told a lie, and that the other speaker was a dishonest cad. As in past experiments, old people had trouble remembering which voice spoke a given line. But those who were clued in to the trustworthiness of the speakers readily judged whether a given statement was likely to be true or false, suggesting that old subjects can remember information about the source of a memory when it's important to them.

Old people engage the world in a distinctive way, and memory tests are notoriously



The old view. Researchers now question the assumption that most cognitive abilities are doomed to decay with age; language skills yield high scores in the 70s.

susceptible to the level of engagement. To demonstrate how the same information can make a big impression or fade from memory, Hess's team asked young and old subjects to listen to a drawn-out description that was identified as either someone's experiences in a first job or their experiences while searching for a retirement home. Young people remembered details from both scenarios well; the job description slipped from older subjects' minds, but their memories for the housing search were keen.

Hasher points to a theme unifying such studies: Age differences are robust when researchers "ask for a piece of information that just doesn't matter much. But if you ask for information that's important, old people do every bit as well as young adults." As Hess puts it, "young people have [mental] resources to burn. As people get older, they get more selective in how they use their resources."

Automatic drive

A few classic tests of cognitive abilities show improvements over a lifetime. In a massive study of people of many different ages, psychologist Denise Park of the University of Illinois, Urbana-Champaign,

and colleagues showed that, as expected, many skills tank with age. These include basic skills such as short-term memory and speeded processing, which are often tested, respectively, by having someone recite back a list of numbers or make a snap decision about whether two columns of letters match. In contrast, verbal abilities continue to shine even in 80-year-olds, the researchers reported last year in *Psychology and Aging* (*Science*, 21 June 2002, p. 2131).

Tests of vocabulary and the ability to pick synonyms and antonyms are fairly straightforward ways to measure what Park calls knowledge about the world. People build such knowledge over a lifetime and develop many areas of expertise that help them compensate for age-related declines.

Park and others distinguish between highly practiced skills that become automatic—such as using words correctly—and those that require new learning, such as picking up a new language. Activities that require a lot of effort on the part of a young person may be fairly automatic in someone who's been around a while and cultivated them. For instance, Park explains, a senior researcher has plenty of experience in giving a talk. She knows her

way around a slide projector, is accustomed to looking out at a sea of drowsy faces, and may have presented some of the same slides in the past. A junior scientist may fumble with the minutiae and end up giving a worse talk.

When people continue to practice something, such as playing chess or the piano, they can compensate for age-related declines such as shorter attention spans or hesitant fingers. But with only so many practice hours in a day, says psychologist Paul Baltes of the Max Planck Institute for Human Development in Berlin, "the domains in which older people do well will become fewer and fewer." As a result, healthy old people choose the skills that are important to them, continue to stay active in those milieus, and thus maintain a high level of functioning.

One domain that is relatively well preserved in many old people is social wisdom, which Baltes's team measures as an ability to find sensible solutions to life problems. For instance, people are asked how they might advise a 15-year-old girl who wants to run away and get married. "Wisdom is the prototype of positive aging," says Baltes.

Many older people “invest themselves in social and emotional competence.”

Looking on the bright side

Social wisdom isn't limited to performance on lab tests; Carstensen and others have found that older people handle interpersonal conflicts more effectively than do younger people. In this way, as in many others, the old seem particularly adept at maintaining mental health—or so they say about themselves. The reasons are somewhat disputed. Carstensen has evidence that older people, conscious of their limited life expectancies, concentrate on making the here and now more meaningful and rewarding. In a somewhat less flattering light, Baltes suggests that many older people compare themselves to those less fortunate in order to maintain satisfaction with their lives.

The study of emotional health and aging is fairly new. Carstensen suggests that's because “researchers absolutely knew, they were confident, that the story would be the same [one] that is told about physical aging”—namely, that emotional health would ebb with advancing years. But in fact, “emotional experience and regulation improve with age, despite the real onslaught of losses that aging does entail.”

Many differences in how old and young people learn and remember things, Carstensen says, are a result of how they see the world. Young people, she says, see the future as open-ended and favor learning new things. Over the years, attention shifts to the present: “People live in the moment, not preparing for the future. . . . They deepen emotional relationships and tend to savor life.”

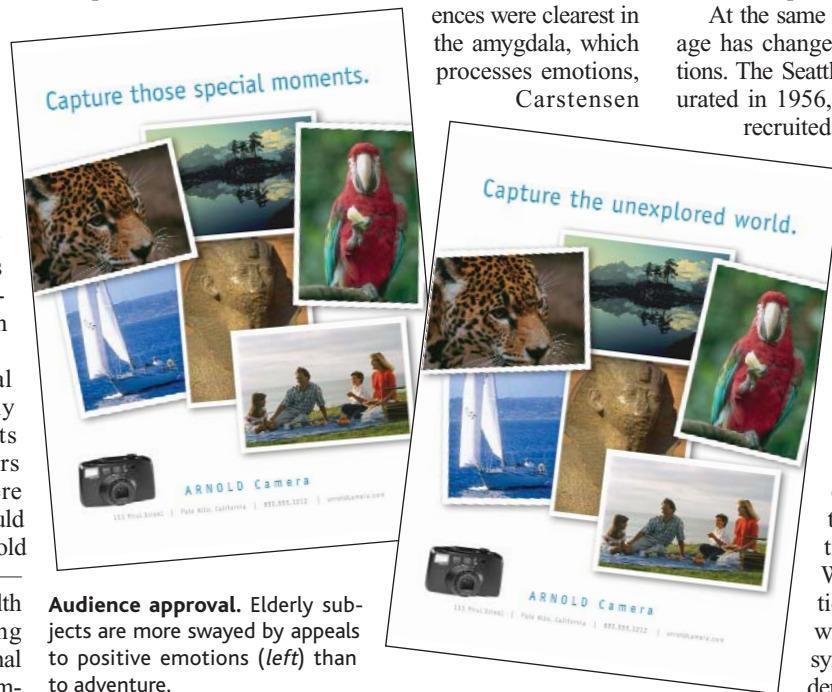
For instance, given an advertisement for a camera with the slogan “Capture the unexplored world” or “Capture those special moments,” young subjects are more drawn to the expand-your-horizons theme. Old subjects prefer the second appeal—to family and positive emotions—and remember such slogans more easily, Carstensen's team reports in an upcoming issue of the *Journal of Personality and Social Psychology*.

Old people also respond differently to positive and negative stimuli. Studies typically show that people are more likely to remember the negative. But such studies also typically consist of college students. Older subjects, Carstensen found, show the opposite bias. They're more likely to remember

quickly flashed pictures showing positive scenes, such as a child's birthday party, than negative scenes, such as a burn victim.

To see how young and old people process such images, Carstensen and John Gabrieli's team at Stanford flashed positive and negative scenes while scanning brain activity. Young subjects' brains, as in past experiments, showed more activity in response to negative images, but old subjects' brains lit up more brightly in response to the positive ones. The differences were clearest in the amygdala, which processes emotions,

Carstensen



Audience approval. Elderly subjects are more swayed by appeals to positive emotions (left) than to adventure.

reported at a November 2002 meeting at the New York Academy of Sciences. The study reinforces Carstensen's contention that older people have a different view of the world. “Absolutely, at the initial stages of processing,” older people record information differently than do the young.

But this bias could have negative side effects, Carstensen says. Old people may overlook unpleasant but critical facts affecting their lives, such as deficiencies in health insurance plans. Positivity bias even colors autobiographical memory. Carstensen and Quinn Kennedy of the Veterans Administration hospital in Palo Alto, California, recently gave nuns a lengthy questionnaire identical to one they'd completed in 1987. When asked to fill out the form based on how they'd felt years earlier, the nuns remembered greater physical, mental, and emotional health than they had actually enjoyed.

Baltes finds a slightly different bias in older people's thinking. Many of them maintain a sense of well-being, he says, by seeking out examples of people who are even worse off than they are. “Someone who has a heart attack and survives compares him-

self to someone who died, and [he then] feels better,” says Baltes. “In my view, that's one of the primary reasons the old don't do badly” in terms of life satisfaction.

Baltes, a director of a longitudinal aging study in Berlin, cautions that much of the successful aging revealed by recent studies is based on the performance of what he calls the “young old”—those in their 60s and 70s. Once people hit the “old old” years of 80 and above, he finds, they're much less likely to be able to compensate for the ravages of age.

At the same time, the nature of youth and age has changed over the past few generations. The Seattle Longitudinal Study, inaugurated in 1956, tests continuing and newly recruited participants on a variety of cognitive measures at 7-year intervals. Today's elders are unlikely to have graduated from high school, says Sherry Willis of Pennsylvania State University, University Park, but half of the study's younger cohort, as in the population in general, has at least some post-high school education. Even so, no generation can beat those born in the 1920s for adding and subtracting two-digit numbers, Willis says. In the past, education was more rote, she says, with less emphasis on thinking symbolically or discovering underlying algorithms. Comparing tests taken at the same chronological age, she finds that successive generations are better at problem solving and other age-related skills.

Some of later generations' edge can be attributed to improved physical health, NIA's Wagster points out, stemming from better detection, treatment, and prevention of disease. Type II diabetes and cardiovascular disease, for instance, can interfere with mental activity.

The question of how to slow age-related declines is “ripe for the picking,” says Wagster. Some studies suggest that remaining mentally and socially active protects against Alzheimer's disease; others show that physical exercise can improve cognitive abilities. Training older people on strategies to improve memory, problem solving, and processing speed does improve their performance, Willis and colleagues reported in November 2002 in the *Journal of the American Medical Association*. But training in one domain didn't transfer to the others. Willis foresees a mental antiaging regimen akin to what fitness buffs adhere to: “We may need to do cross-training in mental exercises to totally tone you up.”

—LAURA HELMUTH