

Late Adulthood: Cognitive Development

WHAT WILL YOU KNOW?

1. How does the brain simultaneously grow and shrink in old age?
2. What kinds of memory are least apt to fade in old age? What kinds are the most apt to fade?
3. What is the difference between these four terms: Alzheimer, senility, dementia, and neurocognitive disorders?
4. What gains in cognition occur in late adulthood?

I have eaten many dinners sponsored by large organizations. I am tired of them. No longer do I enjoy church suppers with lasagna and Jell-O/marshmallow salad; no longer do I appreciate chicken and chocolates at nonprofit fundraisers; I am not impressed with a choice of red or white wine and rare or well-done roast beef at corporate events.

But recently hundreds of other people and I attended an organization's dinner that was unlike the rest. The appetizer was a cold kale and nut salad; the fish entrée was passed around family style; and the guests were mostly young, lean, and earnest. It was a celebration of 40 years of a group that works for pedestrian safety, protected bike lanes, and metered parking. Most of the patrons arrived by foot, subway, or bicycle.

This chapter on cognition in late adulthood begins with this event because each generation has its own concept of how things should be. Challenging our conceptions is one of the things people of other ages do for us.

My assumptions were challenged and my ideas grew, not only by the menu but also by the conversation and the speeches. Piaget thought intelligence was the ability to expand the mind whenever disequilibrium requires new thinking. Of course, Piaget's fourth and final major intellectual expansion was formal operational thought during adolescence. But his insight applies to late adulthood as well: New experiences require deeper, better thinking. That is what research on the brain suggests.

I have not changed my basic values, but that dinner did expand my understanding. Cognitive development is a lifelong process, propelled by new experiences and reassessments.

This chapter describes the many intellectual losses of late adulthood in sensory input, memory, and output. But there are gains as well, including gains in thought and expression. You will also learn about neurological diseases that become more frequent as people grow older, including Alzheimer disease. Understanding them will entail some disequilibrium as you read: Many people have distorted ideas about aging, as is evident from the use of "senility," a word that itself is a distortion.

One theme is evident throughout: Older people can become wiser, but they do not always do so. Intellectual prowess after age 65 requires that people attend to aspects of life that require new concepts or skills. As you will see, this may include playing video games, or lifting weights, or storytelling, or painting, or singing, or staying on the job. For me, it included going to dinner.



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Still at Work Roger Lesch (a) is shown here at age 65, the age when police in Rockport, Massachusetts must retire. Two decades earlier Lesch started protecting the elderly from scams and safeguarding those who wandered. He turned down a promotion which would have halted his senior work. Neither he nor anyone else wanted him to quit, so Rockport appointed him "special officer for elder affairs," which allowed him to continue working in uniform. Eric Headley (b), here age 74, drives a van for his job in London. He can no longer be forced to quit. A 2011 English law forbade mandatory retirement.



(a)



(b)

>> The Aging Brain

Ageism impairs elders in many ways, but the most feared and insidious impairment involves the mind, not the body. As with many stereotypes, the notion of cognitive decline in late adulthood begins with a half-truth and then stops too soon. In fact, "although many 70- to 80-year-old adults show evidence of age-related decline, some continue to maintain very high levels of cognitive performance" (Nyberg & Bäckman, 2011). The fear is worse than the facts.

New Brain Cells

The most exciting news regarding brain development in later life is that neurons form and dendrites grow in adulthood. That surprised many scientists when it was first discovered. Almost everyone thought that humans developed no new brain cells after infancy.

We now know that neurons develop in the adult brain particularly in two specific areas, the olfactory region (smelling) and the hippocampus (remembering).

Some antidepressants create new neurons that repair damage to the hippocampus caused by earlier stress hormones (Surget et al., 2011). In addition, old neurons can develop new dendrites, allowing adults to shake the grip of depression and anxiety (Mateus-Pinheiro et al., 2013).

Although neurogenesis may occur in many living things, an evolutionary perspective suggests that the generation of new neurons in humans may occur for unique reasons (Kempermann, 2012). When agriculture began (widely believed to be approximately 10,000 years ago), adult life started to require more planning, remembering, and strategizing than was previously necessary. People faced more complexities in nourishing the population than was the case with the nomadic hunting and gathering that earlier humans did and that wild animals still do. Further, the brain adjusted as humans faced the new challenges of gathering in towns, which meant they had to interact with much larger social groups.

The idea that the complex social interactions of human life led to new brain development is an attractive one. As one scholar suggests, "moving actively in a changing world and dealing with novelty and complexity regulate adult neurogenesis. New neurons might thus provide the cognitive adaptability to conquer ecological niches rich with challenging stimuli" (Kempermann, 2012, p. 727).

As you remember from Chapter 21, in the twentieth century the evidence suggests that the intellectual ability of each new cohort is better than that of the previous one. Perhaps the increasing complexity of modern life requires continuing

Especially for People Who Are Proud of Their Intellect What can you do to keep your mind sharp all your life? (see response, page 702)



improvement, with urbanization and globalization demanding intellectual expansion. Thus older people who continue to cope with challenges will continue to grow new neurons.

The positive finding that neurons are created is tempered by a more negative one—growth of the brain in late adulthood is slow and limited (Lee et al., 2012), and treatment for various illnesses may kill neurons without creating new ones (Mojica & Dietrich, 2012; Mashour & Avidan, 2013). New neurons develop, but their creation and growth are less robust than earlier in life, and not sufficient to restore the aging brain to its earlier state.

Senescence and the Brain

The cold fact that senescence affects the brain has been known for decades. Recent research has brought the good news that new brain cells and dendrites can develop, but the old news is still true—brains slow down with age.

Slower Thinking

Senescence reduces the production of neurotransmitters—glutamate, acetylcholine, serotonin, and especially dopamine—that allow a nerve impulse to jump quickly across the synaptic gap from one neuron to another. Neural fluid decreases, myelination thins, and cerebral blood circulates more slowly. The result is an overall slowdown of the brain, evident in reaction time, movement, speech, and thought.

This slowdown can prove a severe drain on the intellect because speed is crucial for many aspects of cognition. In fact, some experts believe that processing speed is the *g* mentioned in Chapter 21—the intellectual ability that underlies all other aspects of intelligence (Salthouse, 2004).

Deterioration of cognition correlates with slower movement as well as with almost every kind of physical disability (Kuo et al., 2007; Salthouse, 2010). For example, gait speed correlates strongly with many measures of intellect (Hausdorff & Buchman, 2013). Walks slow? Talks slow? Oh no—thinks slow!

Smaller Brains

Brain aging is evident not only in processing speed but also in size, as the total volume of the brain becomes smaller. Shrinkage is particularly notable in the hippocampus and the areas of the prefrontal cortex that are needed for planning, inhibiting unwanted responses, and coordinating thoughts (Rodrigue & Kennedy, 2011).

In every part of the brain, the volume of gray matter (crucial for processing new experiences) is reduced, in part because the cortex becomes thinner with every decade of adulthood (Zhou et al., 2013). As a consequence, many people must use their cognitive reserve (Park & Reuter-Lorenz, 2009). White matter generally is reduced as well, slowing the mind. However, white matter also increases in an odd way: Bright white spots appear on MRIs after age 50 or so.

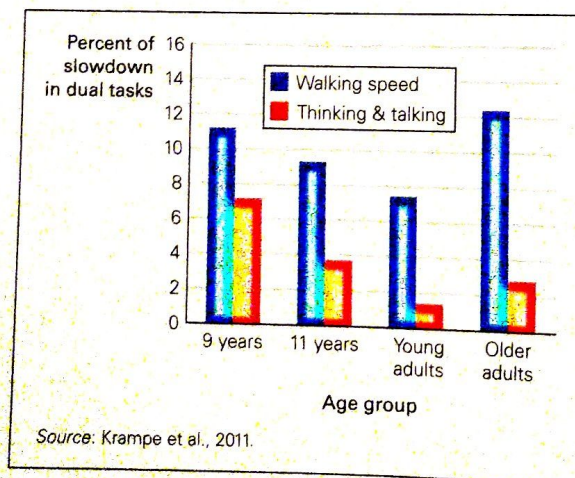
These white matter lesions are thought to result from tiny impairments in blood flow. They increase the time it takes for a thought to be processed in the brain (Rodrigue & Kennedy, 2011). Slowed transmission from one neuron to another is not the only problem. With age, transmission of impulses from entire regions of the brain, specifically from parts of the cortex and the cerebellum, is disrupted. Specifics correlate more with cognitive ability than with age (Bernard et al., 2013).

>> Response for People Who Are Proud of Their Intellect (from page 700): If you answered, "Use it or lose it" or "Do crossword puzzles," you need to read more carefully. No specific brain activity has proved to prevent brain slowdown. Overall health is good for the brain as well as for the body, so exercise, a balanced diet, and well-controlled blood pressure are some smart answers.

Observation Quiz In the figure below, how much were the 9-year-olds affected by doing both tasks at once? (see answer, page 704)

FIGURE 24.1

One Task at a Time Doing two things at once impairs performance. In this study, researchers compared the speed of a sensorimotor task (walking) and a cognitive task (naming objects within a category—for example, naming as many colors, spices, insects, crimes, four-legged animals as possible within a minute or two). The participants did each task separately first, and then they did both at once. Performing them both at once resulted in performance losses for everyone. Note, however, that the eldest seemed to safeguard verbal fluency (only a 3 percent slowdown) at the expense of significantly slower walking.



Variation in Brain Efficiency

As with every other organ, all the aspects of brain senescence vary markedly from individual to individual, in part because of the individual's health and habits. Higher education and vocational status correlate with less cognitive decline. There are three plausible hypotheses for the connection between high SES and high intellect:

1. High-SES people began late adulthood with more robust and flexible minds, so their losses are not as noticeable.
2. Keeping the mind active is protective.
3. High-SES people generally avoid pollution and drugs, and have better medical care than low-SES people.

The first hypothesis seems to have the greatest amount of research support. The intellectually gifted may lose cognitive speed at the same rate as other people, but they began late adulthood as such quick thinkers that the slowdown is less apparent (Puccioni & Vallesi, 2012). But the second hypothesis also has support. The intellectually gifted are more open to new ideas, and that openness produces a more active mind (Hogan et al., 2012). This is the "use it or lose it" hypothesis, an attractive idea that has many of the elderly doing crossword puzzles and Sudoku, but not one that researchers have proven.

Finally, no one doubts that health is crucial. Exercise, nutrition, and normal blood pressure are powerful influences on brain health, and these factors predict intelligence in old age. Some experts contend that with good health habits and favorable genes, no intellectual decrement will occur (Greenwood & Parasuraman, 2012).

Variation is also evident in which parts of the brain shut down first. Names are forgotten faster than faces, spatial representation (where did I put that?) faster than vocabulary (what is that called?). This variation may be strictly biological (hypothesis one) or a matter of practice (hypothesis two). No doubt it is affected by blood circulation in the brain (hypothesis three).

Using More of the Brain

A curious finding from PET and fMRI scans is that, compared with younger adults, older adults use more parts of their brains, including both hemispheres, to solve problems. This may be compensation: Using only one brain region may no longer be sufficient if that part has shrunk, so the older brain automatically activates more parts.

Consequently, older adults are as intellectually sharp as they always were on many tasks. However, in performing difficult tasks that require younger adults to use all their cognitive resources, older adults are less proficient, perhaps because they already are using their brains to the max (Cappell et al., 2010).

Brain shrinkage interferes with multitasking even more than with other cognitive challenges. No one is intellectually as efficient with two tasks as with one, but young children and old adults are particularly impaired by doing several tasks (Krampe et al., 2011) (see Figure 24.1). Recognizing this fact, many elders are selective; they sequence tasks rather than try to do two things at once.

Suppose that a man is interrupted by his grandchild's questions while reading the newspaper, or that grandchild asks grandmother which bus to take while she is getting dressed. A wise man puts down the newspaper and then answers, and grandmother will first dress and then think about transportation (avoiding mismatched shoes).



WARMING UP

The human brain is constantly changing and developing as long as a person is alive, even adding new cells and growing new dendrites. However, like every other body part, the brain shows signs of age. It becomes smaller overall. Some parts are particularly likely to shrink, especially gray matter, the prefrontal cortex, and the hippocampus. Neurotransmitters, myelination, and white matter are also reduced, with new, intense white spots. The result of all these changes is that the transmission of messages from one neuron to another slows, which is evident in how fast people move their bodies (such as walking) and how quickly they remember a name.

Remarkable plasticity is also apparent, with wide variation in the rate and specifics of brain slowdown. In general, older adults use more of their brains, not less, to do various tasks, and they prefer doing one task at a time, avoiding multitasking.

➤ Information Processing After Age 65

Given the complexity, variation, and diversity of late-life cognition, we need to examine specifics to combat general stereotypes. For this purpose, the information-processing approach is useful, with details of input (sensing), memory (storage), control processes (programming), and output.

Input

The first step in information processing is input, in which the brain receives information from the senses, but, as Chapters 20 and 23 explain, no sense is as sharp at age 65 as at age 15. Glasses and hearing aids mitigate severe sensory losses, but more subtle deficits impair cognition as well. In order to be perceived, information must cross the *sensory threshold*—the divide between what is sensed and what is not. [Lifespan Link: Sensory memory is explained in Chapter 12.]

A person may not recognize sensory losses because the brain automatically fills in missed sights and sounds. People of all ages believe they look at the eyes of their conversation partner, yet a study that examined the ability to follow a gaze found that older adults were less adept at knowing where someone was looking (Slessor et al., 2008). That creates a disadvantage in social interactions. Another study found that already by age 50, adults were less adept at reading emotions by looking at the eyes (Pardini & Nichelli, 2009).

Acute hearing is another way to detect emotional nuances. Older adults are less able to decipher the emotional content in speech, even when they hear the words correctly (Dupuis & Pichora-Fuller, 2010). Particularly for them, understanding speech is impaired when vision is impaired (Tye-Murray et al., 2011), probably because watching lips and facial expressions aids understanding. Thus, small sensory losses—not noticed by the person or family but inevitable with age—impair cognition.

I know a father—not elderly but already with fading eyesight—who was scolding his 6-year-old daughter. Without his glasses, he could not see that her lip had started to quiver. He was surprised when she cried; he did not realize how harsh his words seemed to her.

The cognition of almost 2,000 intellectually normal older adults, average age 77, was repeatedly tested 5, 8, 10, and 11 years after the initial intake (Lin et al., 2013). At the 5-year retesting, an audiologist assessed their hearing. Between the start of the study and 11 years later, the average cognitive scores of the adults with hearing loss (who were often unaware of it) were down 7 percent, while those with normal hearing lost 5 percent.

>> **Answer to Observation Quiz** (from page 702): Nine-year-olds were the only group to slow down significantly in both tasks. Impairment was about 11 percent in walking and 7 percent in naming within a category.

That 2 percent difference seems small, but statistically it was highly significant (.004). Furthermore, greater hearing losses correlated with greater cognitive declines (Lin et al., 2013). Many other researchers likewise find that small input losses have a notable effect on output.

Memory

After input, the second step is processing whatever input has come from the senses. Stereotype threat impedes this processing. [**Lifespan Link:** Stereotype threat was discussed in Chapter 18.] If older people suspect memory loss, anxiety itself impairs their memory (Ossher et al., 2013). Worse than that, simply knowing that they are taking a memory test makes them feel years older (Hughes et al., 2013). As you learned in Chapter 23, feeling old itself impairs health.

The more psychologists study memory, the more they realize that memory is not one function but many, each with a specific pattern of loss. Some losses of the elderly are quite normal and others pathological (Markowitsch & Staniloiu, 2012). The inability to recall a word or a name is a normal loss of one aspect of memory, and does not indicate that memory, overall, is fading.

Generally, explicit memory (recall of learned material) shows more loss than implicit memory (recognition and habits). That means that names are harder to remember than actions. Grandpa can still swim, ride a bike, and drive a car, even if he cannot name both U.S. senators from his state.

One memory deficit is *source amnesia*—forgetting the origin of a fact, idea, or snippet of conversation. Source amnesia is particularly problematic in the twenty-first century, as video, audio, and print information bombard the mind.

In practical terms, source amnesia means that elders might believe a rumor or political advertisement because they forget the source. Compensation requires deliberate attention to the reason behind a message before accepting a con artist's promises or the politics of a TV ad. However, elders are less likely than younger adults to analyze, or even notice, information surrounding the material they remember (Boywitt et al., 2012).

Another crucial type of memory is called *prospective memory*—remembering to do something in the future (to take a pill, to meet someone for lunch, to buy milk). Prospective memory also fades notably with age (Kliegel et al., 2008). This loss becomes dangerous if, for instance, a person cooking dinner forgets to turn off the stove, or if someone is driving on the thruway in the far lane when the exit appears.

The crucial aspect of prospective memory seems to be the ability to shift the mind quickly from one task to another: Older adults get immersed in one thought and have trouble changing gears (Schnitzspahn et al., 2013). For that reason, many elders follow routine sequences (brush teeth, take medicine, get the paper) and set an alarm to remind them to leave for a doctor's appointment. That is compensation.

Working memory (remembering information for a moment before evaluating, calculating, and inferring its significance) also declines with age. Speed is critical: Some older individuals take longer to perceive and process sensations, which reduces working memory because some items fade before they can be considered (Stawski et al., 2013).

For example, a common test of working memory is to have someone repeat backwards a string of digits just heard, but if the digits are said quickly, a slow-thinking person may be unable to process each number and then hold them all in memory. Speed of processing would explain why memory for vocabulary

Especially for Students If you want to remember something you learn in class for the rest of your life, what should you do? (see response, page 706)



especially recognition memory, not recall) is often unaffected by age. For instance, speed is irrelevant in knowing that *chartreuse* is a color, not an animal.

Some research finds that when older people have adequate time, working memory does not fade. Speed is crucial when comparing working memory between one older adult and another, but paying attention becomes the critical factor when a person is tested repeatedly over several days (Stawski et al., 2013).

Thus, adequate time and careful attention are both crucial. This explains interesting results from a study of reading ability. In that research, older people reread phrases more often than younger people did, but when both groups had ample time to pay attention, comprehension was not impaired by age (Stine-Morrow et al., 2010).

Control Processes

The next step in information processing involves control processes (discussed in Chapter 12). Many scholars believe that the underlying impairment of cognition in late adulthood is in this step, as information from all parts of the brain is analyzed by the prefrontal cortex. Control processes include selective attention, strategic judgment, and then appropriate action—the so-called *executive function* of the brain.

Instead of using analysis and forethought, the elderly tend to rely on prior knowledge, general principles, familiarity, and rules of thumb as they make decisions (Peters et al., 2011), basing actions on past experiences and current emotions.

For example, casinos have noticed that elderly gamblers gravitate to slot machines rather than to games where analysis is helpful. The reason, according to a study of brain scans of young and old slot players, is that the activated parts of older brains are less often the regions in which analysis occurs (McCarrey et al., 2012). When gamblers are able to analyze the odds, as younger players do, they spend less time with slots.

A VIEW FROM SCIENCE

Cool Thoughts and Hot Hands

As you remember from the discussion of dual processing in Chapter 15, experiential, emotional thinking is not always faulty, but sometimes analytic thinking is needed to control impulsive, thoughtless reactions.

This was apparent in a study of belief in the “hot hand,” which is the idea that athletes are more likely to score if they scored in the immediately previous attempts. One study found that most people (91 percent) believe that players can be “on a roll” or that teams can have “a winning streak” (Gilovich et al., 1985).

Most people are wrong about this; the hot hand is an illusion. Of course, the best players are more likely to score than the worst ones, but statistical analysis from basketball, golf, and other sports finds that one successful shot does not affect the chance that a particular player will make the next one.

People want to believe in streaks, so they forget when streaks do not occur. This misperception has become a classic example

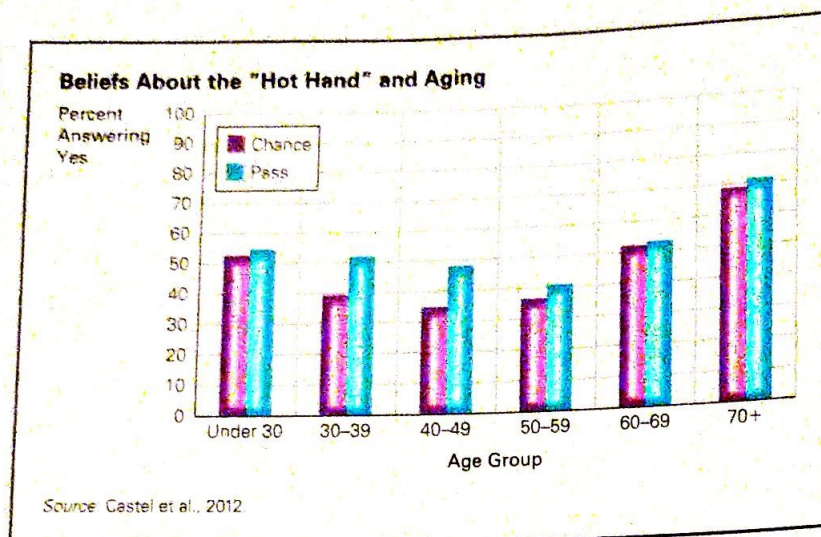
of the human tendency to ignore data that conflicts with assumptions (Kahneman, 2011).

Do people become more or less likely to follow their preconceptions rather than using logic to consider new information as they age? In one study, 455 people aged 22 to 90 were told that, overall, about half the time basketball shots miss. That was supposed to remind them to think analytically, not emotionally. Then they were asked two questions:

Does a basketball player have a better chance of making a shot after having just made the last two or three shots than after missing the last two or three shots?

Is it important to pass the ball to someone who has just made several shots in a row?

The correct answer to both questions is No, but in this study, elders were particularly likely to say Yes, sticking to their hot hand belief (Castel et al., 2012) (see Figure 24.2).

**FIGURE 24.2**

Hard to Chill This shows the percent of adults who answered "Yes" to the two questions, which means that they were not thinking analytically. As you see, the oldest participants were most likely to stick to their "hot hand" prejudice. However, also notice that about one-fourth of those over 70 answered correctly and almost half of the younger adults did not. In this and every other study, age is only one of many factors that influence cognition.

>> Response for Students (from page 704): Learn it very well now, and you will probably remember it in 50 years, with a little review.

One particular control process is development of strategies for retrieval. Some developmentalists believe that impaired retrieval is an underlying cause of intellectual lapses in old age because elders have many thoughts and memories that they cannot access. Since deep thinking requires recognizing and comparing the similarities and differences in various experiences, if a person cannot retrieve memories of the past, new thinking is more shallow than it might otherwise be.

Inadequate control processes may explain why many older adults have extensive vocabularies (measured by written tests) but limited fluency (when they write or talk), why they are much better at recognition than recall, why tip-of-the-tongue forgetfulness is common, and why spelling is poorer than pronunciation.

Many gerontologists think elders would benefit by learning better control strategies. Unfortunately, even though "a high sense of control is associated with being happy, healthy, and wise," many older adults resist suggested strategies because they believe that declines are "inevitable or irreversible" and that no strategy can help (Lachman et al., 2009, p. 144). Efforts to improve their use of control strategies are often discouraging (McDaniel & Bugg, 2012).

Output

The final step in information processing is output. In daily life, output is usually verbal. If the timbre and speed of a person's speech sounds old, ageism might cause listeners to dismiss the content without realizing that the substance may be profound. Then, if elders realize that what they say is ignored, they talk less. Output is diminished. This provides guidance for anyone who wants to respect and learn from someone else: We all talk more if we think someone is listening appreciatively.

Scientists usually measure output through use of standardized tests of mental ability. As already noted, if older adults think their memory is being tested, that alone impairs them (Hughes et al., 2013). Even without stereotype threat, output on cognitive tests may not reflect ability, as you will now see.

Cognitive Tests

In the Seattle Longitudinal Study (described in Chapter 21), the measured output of all five primary mental abilities—verbal meaning, spatial orientation, inductive reasoning, number ability, and word fluency—declined, beginning at about



age 60. This decline was particularly notable in spatial perception and processing speed (Schaie, 2013).

Similar results are found in many tests of cognition: Thus, the usual path of cognition in late adulthood as measured by psychological tests is gradual decline, at least in output (Salthouse, 2010). However, such tests are normed and validated via the output of younger adults. To avoid cultural bias, many questions are quite abstract and timed, since speed of thinking correlates with intelligence for younger adults. A smart person is said to be a "quick" thinker, the opposite of someone who is "slow."

But abstract thinking and processing speed are the aspects of cognition that fade most with age. Is there a better way to measure output in late adulthood?

Ecological Validity

Perhaps ability should be measured in everyday tasks and circumstances, not as laboratory tests assess it. To do measurements in everyday settings is to seek **ecological validity**, which may be particularly important when measuring cognition in the elderly (Marsiske & Margrett, 2006).

For example, because of changes in their circadian rhythm, older adults are at their best in the early morning, when adolescents are half asleep. If a study were to compare 85-year-olds and 15-year-olds, both tested either at 8 A.M. or at 4 P.M., comparisons would reflect time of day, not just mental ability. Ecological validity might require different testing times for each age group.

Similarly, if intellectual ability were to be assessed via a timed test, then faster thinkers (usually young) would score higher than slower thinkers (usually old), even if the slower ones would be more accurate with a few more seconds to think. Furthermore, contextual effects might cause anxiety, for instance, if the test occurred in a college laboratory.

Indeed, age differences in prospective memory are readily apparent in laboratory tests but disappear in some naturalistic settings, a phenomenon called the "prospective memory-paradox" (Schnitzspahn et al., 2011). Motivation seems crucial; elders are less likely to forget whatever they believe is important—phoning a child on their birthday, for instance.

Similarly, as already noted, older adults are not as accurate as younger adults when tested on the ability to read emotions by looking at someone's face or listening to someone's voice. But seeing and hearing are less acute with age, so they may not be the best way to measure empathy in older adults. Accordingly, a team decided to measure empathy when visual contact was impossible.

Their study included a hundred couples who had been together for years, and each of the participants was repeatedly asked to indicate their own emotions (how happy, enthusiastic, balanced, content, angry, downcast, disappointed, nervous they were) and to guess the emotions of their partner at that moment. Technology helped with this: The participants were beeped at various times, and indicated their answers on a smart phone they kept with them. Sometimes they happened to be with their partner, sometimes not.

When the partner was present, accuracy was higher for the younger couples, presumably because they could see and hear their mate. But when the partner was absent, the older participants were as good as the younger ones (see Figure 24.3). Could you

predict a social partner's feelings when that person is absent? Your judgment would probably be better than chance, and although many abilities deteriorate with aging, this particular ability may remain reliable throughout your life.

[Rauers et al., 2013, p. 2215]

ecological validity The idea that cognition should be measured in settings and conditions that are as realistic as possible and that the abilities measured should be those needed in real life.

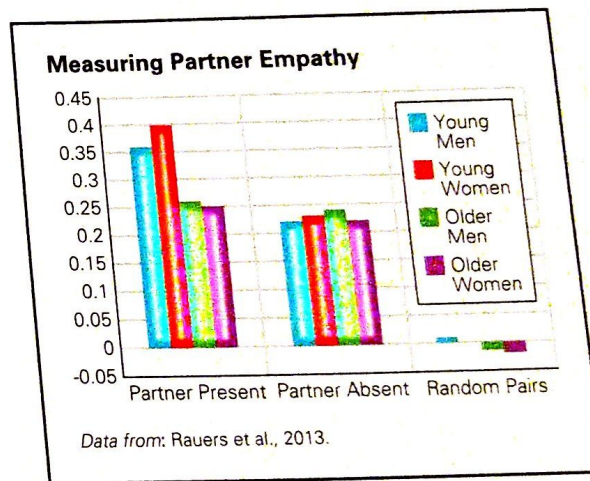


FIGURE 24.3

Always on My Mind When they were together, younger partners were more accurate than older ones at knowing their partner's emotions, but older partners were as good as younger ones when they were apart. This study used "smart phone experience sampling," buzzing both partners simultaneously to ask how they and their partner felt. Interestingly, differences were found with age but not length of relationship—ten, twenty, or thirty years of togetherness did not necessarily increase empathy when apart, but men who were in their 70s were better at absent mood assessment than men in their 20s.

The fundamental ecological issue for developmentalists is what should be assessed—pure, abstract thinking or practical, contextual thought, depersonalized abilities, or everyday actions? Traditional tests of cognition emphasize fluid abilities, but problem solving and emotional sensitivity may be more crucial. Fluid practical abilities are not measured by traditional cognitive tests.

Awareness of the need for ecological validity has helped scientists restructure research on memory. Restructured studies find fewer deficits than originally thought. However, any test may overestimate or underestimate ability. For instance, what is an accurate test of long-term memory? Many older people recount, in vivid detail, events that occurred decades ago. That is impressive . . . if the memories are accurate.

Unfortunately, “there is no objective way to evaluate the degree of ecological validity . . . because ecological validity is a subjective concept” (Salthouse, 2010, p. 77). It is impossible to be totally objective in assessing memory; memory is always subjective.

OPPOSING PERSPECTIVES

How to Measure Output

Finding the best way to measure cognition is particularly important if a decision is to be made as to whether an older person is able to live independently. An increasing number of the elderly live alone. Is this safe? Might they forget to turn off the stove, or ignore symptoms of a heart attack, or fall prey to a stranger who wants them to invest their money in a harebrained scheme? Many people seek to protect the elderly from failing cognition while allowing as much independence as possible.

Recently, tests have been developed to measure practical problem solving (Law et al., 2012). Some involve short-term memory with no delay between facts and conclusions. In one such test, for instance, a person reads relevant facts; then the paper is removed and the person is asked to solve a problem based on those facts. Other tests pose practical problems, such as what to do if your refrigerator is warm or if a favorite sweater has a hole in it.

Scores on such tests show less discrepancy between the old and the young than scores on abstract memory tests. Perhaps only when an older person living alone fails practical tests is it time for intervention.

Unfortunately, even tests that attempt to be ecologically valid may be inaccurate (Law et al., 2012). Perhaps the best way to test cognitive ability is to be quite direct, asking questions about missed appointments, lost keys, and so on of a person or of someone who knows them well. Yet even direct questions may not be answered accurately, in part because many of the elderly do not want to admit memory loss. Added to that, many family members and professionals, themselves growing older, do not want to admit to their memory loss—or they may exaggerate it in someone else. Objective measurement might help.

Which of these three measures is best? A study that compared self-assessment, spousal assessment, and tests of intellectual ability found poor correlation among them (Volz-Sidiropoulou & Gauggel, 2012). People did not accurately assess their own memories or those of their partner—with whom they had lived for an average of 30 years.

In that study, the self-assessment questions were ecologically valid, asking practical questions such as how often the person loses things around the house (Volz-Sidiropoulou & Gauggel, 2012). The formal tests of memory were also valid and well established. For instance, the examiner read a list of 15 words and asked the older person to repeat them.

Inaccurate self-assessment is characteristic of people with serious mental illness, as the study authors explain. Those who reported few memory difficulties tended to score poorly on the formal tests; this mistake was thought to be an example of “self-serving bias”—the human tendency to think we are better than we are. That could be dangerous if people are allowed to live alone until they themselves realize they should not. But read the final paragraph of this box before accepting this conclusion.

By contrast, some people in this study reported many memory problems: They typically did better on the formal tests than their self-assessment. The study authors thought this might have been their “way to protect their self-concept by claiming self-handicapping” (Volz-Sidiropoulou & Gauggel, 2012, p. 446). Thus the perspective of researchers was that the elderly are poor at assessing their own cognition.

But wait. Consider an opposing perspective. Is the gap between self-assessment and laboratory results evidence of self-serving bias or self-concept protection, whether the self-assessment is high or low? Or are the tests biased, not the people?



We know that stereotypes are insidious, that global assessments are over-simplified, that emotions affect output. We know that individuals vary, and that some but not all kinds of memory show notable age-related loss.

The final ecological question is, "What is memory for?" Older adults usually think they remember well enough. Fear of memory loss is more typical at age 60 than at age 80. Unless they develop a brain condition such as Alzheimer disease (soon described), elders are correct: They remember how to live their daily lives. Is that enough?

SUMMING UP

Every step in information processing is affected by age. As the senses become less acute, people miss some input. Some stimuli never arrive in the brain, and thus cannot inform thought. Memory also is slower, especially memory for names and places. However, some memories seem intact, including memory for words, emotions, and automatic (implicit) skills.

Impairment in control processes—especially retrieval strategies—may underlie the cognitive deficits of age. Anxiety interferes with every step in information processing. For all these reasons, output is reduced. Every test of cognitive ability shows age-related losses, but in daily life most of the elderly think well enough.

>> Neurocognitive Disorders

The patterns of cognitive aging challenge another assumption: that older people always lose the ability to think and remember. That is not true. Many older people are less sharp than they were, but most are still quite capable of intellectual activity. Others experience serious decline.

The Ageism of Words

It is undeniable that the rate of neurocognitive impairment increases with every decade after age 70. To understand that and prevent the worst of it, caution is needed in using words.

Senile means "old." If senility is used to mean severe mental impairment, that falsely implies that age always brings intellectual failure. *Dementia* was a better term than *senility* for irreversible, pathological loss of brain functioning, but *dementia* also has inaccurate connotations (e.g., "mad" or "insane").

The DSM-5 replaces the term *dementia* with **neurocognitive disorders (NCDs)**. Either *major neurocognitive disorder* or *mild neurocognitive disorder*, depending upon severity of symptoms, is a better way of capturing the range of cognitive impairment and providing the opportunity for early detection and treatment. We use NCD here.

Memory impairment is common in every cognitive disorder. Symptoms of neurocognitive disorders include many more impairments, especially in learning new material, using language, moving the body, and responding to people. Practical examples include getting lost, becoming confused about using common objects like a telephone or toothbrush, or having extreme emotional reactions.

The lines between normal age-related problems, mild disorder, and major disorder are not clearly defined, and the symptoms vary depending on the specifics of brain loss and context. Making distinctions more difficult is that the former word—*dementia*—is still often used in research, and the inaccurate word—*senility*—is used in common speech. Variation is evident in origin as well: more than 70 diseases can cause neurocognitive disorders, each with particular symptoms, sequence, and severity. Equifinality (see Chapter 11) is evident.

neurocognitive disorders (NCDs)

Impairment of intellectual functioning caused by organic brain damage or disease. NCDs may be diagnosed as *major* or *mild*, depending on the severity of symptoms. They become more common with age, but they are abnormal and pathological even in the very old.

The problem of ageist terminology has been recognized internationally. In Japan, the traditional word for neurocognitive disorder was *chihou*, translated as “foolish” or “stupid.” As more people reached old age, the Japanese decided on a new word, *ninchihou*, which means “cognitive syndrome” (George & Whitehouse, 2010). That is similar to the changes in English terminology over the past decades, from senility to dementia to neurocognitive disorder.

Mild and Major Impairment

Many instances of memory loss are not necessarily ominous signs of severe loss to come. Older adults who have significant problems with memory, but who still function well at work and home, might be diagnosed with mild NCD, formerly called *mild cognitive impairment* (MCI). Although some of them will develop major disorders, about half will be mildly impaired for decades or will regain cognitive abilities. For instance, a detailed study of African Americans diagnosed with MCI found that each year, 6 percent developed major losses but 18 percent reverted back to normal (S. Gao et al., 2013).

Many tests are designed to measure mild loss, including one that takes less than 10 minutes—the quick MCI (qmci) (O’Caoimh et al., 2013). The problem with every test is that scores are affected by many factors, with no universally accepted cutoff between normal, mild, and major impairment.

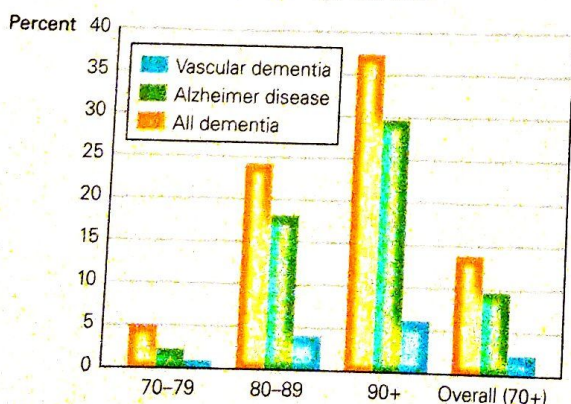
Many scientists seek biological indicators (called *biomarkers*, such as substances in the blood or cerebrospinal fluid) or brain indicators (as found in brain scans) that predict major memory loss. However, although abnormal scores on many tests (biological, neurological, or psychological) indicate possible problems, an examination of 24 such measures found no single test, and no combination of tests, to be 100 percent accurate (Ewers et al., 2012).

The final determinant of neurocognitive disorders is the clinical judgment of a professional who considers all the markers and symptoms—everything from uncontrolled impulses to memory lapses. Any diagnosis may focus too much on losses and not enough on individual strengths. As the previous two sections on brain aging and information processing explain, no very old persons are as intellectually sharp as they once were, so almost everyone could be considered mildly impaired. Opinions are always subjective; objective data can be discounted or overemphasized by both professionals and patients. Diagnosis is complex.

FIGURE 24.4

Not Everyone Gets It Most elderly people never experience a neurocognitive disorder. Among people in their 70s, only 1 person in 20 does, and even by age 90 or 100, most people still think well enough. Presented another way, the prevalent data sound more dire: Almost 4 million people in the United States have a major neurocognitive disorder. (This study used the former term, *dementia*.)

Prevalence of Dementia After Age 70, U.S.



Source: Plassman et al., 2007.

Prevalence of NCD

As you remember from Chapter 23, ageism leads to presentation of statistics in ways that make younger adults recoil with horror. One example is in data about the rising numbers of old people with cognitive problems. We need a more rational understanding.

To find out how many people are truly suffering from cognitive disorders in their older years, researchers selected a representative sample of people 70 years of age and older from every part of the United States, interviewed and examined each one, and spoke with someone who knew them well (usually an immediate relative). They combined this information with test results, medical records, and clinical judgment, and found that 14 percent had some form of major impairment (Plassman et al., 2007) (see Figure 24.4). Extrapolated to the overall population, about 4 million U.S. residents have a serious neurocognitive disorder.



Rates vary by nation, from about 2 to 25 percent of elders, with an estimated 35 million people affected by NCD worldwide (Kalaria et al., 2008; WHO, 2010). Developing nations have lower rates, but that may be because people in the early stages are not counted or because health care overall is poor. (See Visualizing Development, p. 725)

How would poor health care lead to less, not more, impairment? Because many people die before any neurocognitive problems are apparent. People with diabetes, Parkinson's, strokes, and heart surgery are more likely to lose intellectual capacity in old age, but in poor nations many people with those conditions die before age 70. Improvements in health care can reduce cognitive impairment, even as the incidences rise. The three ideal public health goals are (1) better physical health, (2) less mental disorder, and (3) longer lives. That is becoming a reality in some nations.

In England and Wales the rate of dementia for people over age 65 was 8.3 percent in 1991 but only 6.5 percent in 2011 (Matthews et al., 2013). Sweden had a similar decline (Qiu et al., 2013). In China, rates were much higher in rural areas than in urban ones, probably because rural Chinese had less education (Jia et al., 2014). This again suggests that NCD will be reduced as more people understand how to stay healthy.

A comparable survey has not been done in North America, but some signs suggest improvement. Of course, reduction in rate does not necessarily mean reduction in number, since more people live to old age. In England over the past 20 years, the number of people with dementia stayed about the same (Matthews et al., 2013) even while the rate has declined.

Genetics and social context affect rates, but it is not known by how much (Bondi et al., 2009). For example, more older women than men are diagnosed with neurocognitive disorders, which may be genetic, educational, or stress-related. Or it may be simply that women live longer than men (Alzheimer's Association, 2012). Now consider some specific types of age-related neurocognitive disorders.

Alzheimer Disease

In 1906, a physician named Dr. Alois Alzheimer performed an autopsy on a patient who had lost her memory. He found unusual material in her brain; he was uncertain whether it specified a distinct disease (George & Whitehouse, 2010). Others, convinced that he had discovered a disease, named it after him. In the past century, millions of people in every large nation have been diagnosed with **Alzheimer disease (AD)** (now formally referred to as major or mild NCD due to Alzheimer disease). In China, for example, 5.7 million people have Alzheimer disease (Chan et al., 2013).

As Dr. Alzheimer discovered, autopsies reveal that some aging brains have many plaques and tangles in the cerebral cortex. These abnormalities destroy the ability of neurons to communicate with one another, causing severe cognitive loss.

Plaques are clumps of a protein called *beta-amyloid*, found in tissues surrounding the neurons; **tangles** are twisted masses of threads made of a protein called *tau* within the neurons. A normal brain contains some beta-amyloid and some tau, but in brains with AD these plaques and tangles proliferate, especially in the hippocampus, the brain structure crucial for memory. Forgetfulness is the dominant symptom; working memory disappears first.

Although finding massive brain plaques and tangles at autopsy proves that a person diagnosed with NCD had Alzheimer disease, between 20 and 30 percent of cognitively normal elders have, at autopsy, the same levels of plaques in their brains as people who had been diagnosed with AD (Jack et al., 2009). Possibly the normal elders had compensated by using other parts of their brains; possibly they were in the early stages, not yet suspected of having AD; possibly plaques are a symptom, not a cause.

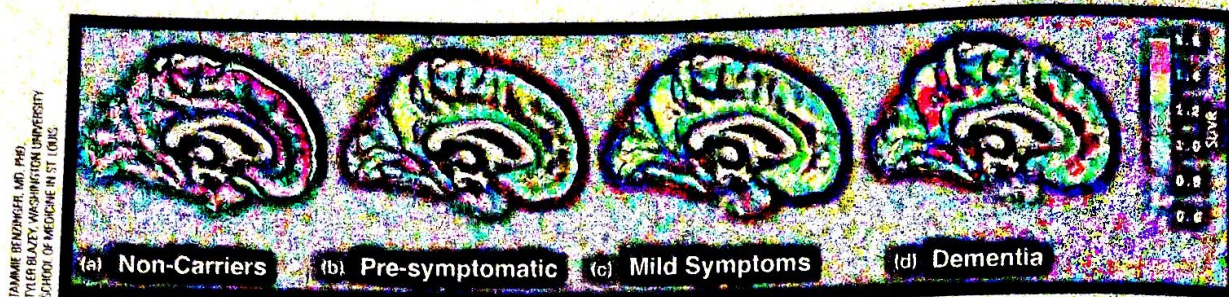
Alzheimer disease (AD) The most common cause of dementia, characterized by gradual deterioration of memory and personality and marked by the formation of plaques of beta-amyloid protein and tangles of tau in the brain. (Sometimes called *senile dementia of the Alzheimer type*.)

plaques Clumps of a protein called *beta-amyloid*, found in brain tissues surrounding the neurons.

tangles Twisted masses of threads made of a protein called *tau* within the neurons of the brain.



The Alzheimer Brain This computer graphic shows a vertical slice through a brain ravaged by Alzheimer disease (*left*) compared with a similar slice of a normal brain (*right*). The diseased brain is shrunken because neurons have degenerated. The red indicates plaques and tangles.



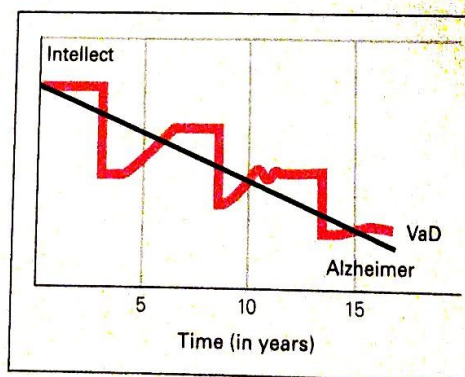
Hopeful Brains Even the brain without symptoms (a) might eventually develop Alzheimer disease, but people with a certain dominant gene definitely will. They have no symptoms in early adulthood (b), some symptoms in middle adulthood (c), and stage-five Alzheimer disease (d) before old age. Research finds early brain markers (such as those shown here) that predict the disease. This is not always accurate, but may soon lead to early treatment that halts AD, not only in those genetically vulnerable, but also in everyone.

Especially for Genetic Counselors Would you perform a test for *ApoE4* if someone asked for it? (see response, page 714)

vascular dementia (VaD) A form of neurocognitive disorder characterized by sporadic, and progressive, loss of intellectual functioning caused by repeated infarcts, or temporary obstructions of blood vessels, which prevent sufficient blood from reaching the brain.

FIGURE 24.5

The Progression of Two NCDs: Alzheimer Disease and Vascular Dementia Cognitive decline is apparent in both Alzheimer disease (AD) and vascular dementia (VaD). However, the pattern of decline for each disease is different. Victims of AD show steady, gradual decline, while those who suffer from VaD get suddenly worse, improve somewhat, and then experience another serious loss.



Frontal Lobe Disorders

Several types of neurocognitive disorders are called **frontal lobe disorders** or *frontotemporal lobar degeneration* (Pick disease is the most common form). These disorders cause perhaps 15 percent of all cases of NCD in the United States. It is particularly likely to occur at relatively young ages (under age 70), unlike Alzheimer or vascular diseases, which typically begin later (Seele et al., 2011).

Alzheimer disease is partly genetic. If it develops in middle age, the affected person either has trisomy-21 (Down syndrome) or has inherited one of three genes: amyloid precursor protein (APP), presenilin 1, or presenilin 2. For these people, the disease progresses quickly, reaching the last phase within three to five years. Most cases begin much later, at age 75 or so. Many genes have some impact, including *SORL1* and *ApoE4* (allele 4 of the *ApoE* gene). People who inherit one copy of *ApoE4* (as about one-fifth of all U.S. residents do) have about a 50% chance of developing AD. Those who inherit two copies almost always develop the disorder if they live long enough.

Vascular NCD

The second most common cause of neurocognitive disorder is a **stroke** (a temporary obstruction of a blood vessel in the brain) or a series of strokes, called **transient ischemic attacks** (TIAs, or ministrokes). The interruption in blood flow reduces oxygen, destroying part of the brain. Symptoms (blurred vision, weak or paralyzed limbs, slurred speech, and mental confusion) suddenly appear.

In a TIA, symptoms may vanish quickly, unnoticed. However, unless it is recognized and preventive action taken, another is likely. Repeated TIAs produce a type of NCD sometimes called **vascular dementia (VaD)**, or *multi-infarct dementia*. The progression of vascular disorder differs from Alzheimer disease, but the final result is similar (see Figure 24.5).

Neurocognitive disorders caused by vascular disease are apparent in many of the oldest-old worldwide. VaD is more common than Alzheimer disease for those over age 90 but not for the young-old. Vascular disorders correlate with the *ApoE4* allele (Cramer & Proenca, 2012) and, for some of the elderly, are caused by surgery that requires general anesthesia. This may cause a ministroke, which, added to reduced cognitive reserve, damages the brain (Stern, 2013).

frontal lobe disorder Deterioration of the amygdala and frontal lobes, which may be the cause of 15 percent of all dementias. (Also called *frontotemporal lobar degeneration* and, in the DSM-5, *frontotemporal NCD*).



To Have and to Hold Ruth wanted to divorce Michael until she realized he suffered from frontal lobe disorder. Now she provides body warmth and comfort in his nursing home bed.

In frontal lobe disorders, parts of the brain that regulate emotions and social behavior (especially the amygdala and prefrontal cortex) deteriorate. Emotional and personality changes are the main symptoms (Seelaar et al., 2011). A loving mother with frontal lobe degeneration might reject her children, or a formerly astute businessman might invest in a harebrained scheme.

Frontal lobe problems may be worse than more obvious types of neurocognitive disease in that compassion, self-awareness, and judgment fade in a person who otherwise seems normal. One wife, Ruth French, was furious because her husband

threw away tax documents, got a ticket for trying to pass an ambulance, and bought stock in companies that were obviously in trouble. Once a good cook, he burned every pot in the house. He became withdrawn and silent, and no longer spoke to his wife over dinner. That same failure to communicate got him fired from his job.

[Grady, 2012, p. A1]

Finally, he was diagnosed with frontal lobe disorder. Ruth asked him to forgive her fury. It is not clear that he understood either her anger or her apology.

Although there are many forms and causes of frontal lobe disorders—including a dozen or so alleles—it usually progresses rapidly, leading to death in about five years.

Other Disorders

Many other brain diseases begin with impaired motor control (shaking when picking up a coffee cup, falling when trying to walk), not with impaired thinking. The most common of these is **Parkinson's disease**, the cause of about 3 percent of all cases of NCD (Aarsland et al., 2005).

Parkinson's disease starts with rigidity or tremor of the muscles as dopamine-producing neurons degenerate, affecting movement long before cognition. Younger adults with Parkinson's disease usually have sufficient cognitive reserve to avoid major intellectual loss, although about one-third have mild impairment (Gao et al., 2013). Older people with Parkinson's develop cognitive problems sooner (Pfeiffer, 2012). If people with Parkinson's live 10 years or more, major neurocognitive impairment almost always occurs (Pahwa & Lyons, 2013).

Parkinson's disease A chronic, progressive disease that is characterized by muscle tremor and rigidity, and sometimes dementia; caused by a reduction of dopamine production in the brain.

>> Response for Genetic Counselors

(from page 712). A general guideline for genetic counselors is to provide clients with whatever information they seek, but because of both the uncertainty of diagnosis and the devastation of Alzheimer disease, the ApoE4 test is not available at present. This may change (as was the case with the test for HIV) if early methods of prevention and treatment become more effective.

Lewy bodies Deposits of a particular kind of protein in the brain that interfere with communication between neurons; Lewy bodies cause neurocognitive disorder.



Who Are You? Ralph Wenzel was a football guard for 7 years in the National Football League, a handsome catch for his wife, Eleanor, shown here. He lost his memory, did not recognize her, and died two years after this photo. His autopsied brain showed CTE, and Eleanor became an advocate for safer football.

Another 3 percent of people with NCD in the United States suffer from an excess of **Lewy bodies**: deposits of a particular kind of protein in their brains. Lewy bodies are also present in Parkinson's disease, but in Lewy body disorder they are more numerous and dispersed throughout the brain, interfering with communication between neurons. As a result, movement and cognition are both impacted. Motor effects are less severe than in Parkinson's disease and memory loss is not as dramatic as in Alzheimer disease (Bondi et al., 2009). The main Lewy body symptom is loss of inhibition: A person might gamble or become hypersexual.

Comorbidity is common with all these disorders. For instance, most people with Alzheimer disease also show signs of vascular impairment (Doraiswamy, 2012). Parkinson, Alzheimer, and Lewy body disorders can occur together. People who have all three experience more rapid and severe cognitive loss (Compta et al., 2011).

Some other types of NCD begin in middle age or even earlier, caused by Huntington disease, multiple sclerosis, a severe head injury, syphilis, AIDS, or bovine spongiform encephalitis (BSE, or mad cow disease). Repeated blows to the head, even without concussions, can cause chronic traumatic encephalopathy (CTE), which first causes memory loss and emotional changes (Voosen, 2013).

Although the rate of NCD increases dramatically with every decade after age 60, brain disease can occur at any age, as revealed by the autopsies of a number of young professional athletes. For them, prevention includes better helmets and fewer body blows. Already, tackling is avoided in professional (NFL) practices.

Changes like these have come too late for thousands of adults, including Derek Boogaard, a star National Hockey League enforcer, who died of a drug overdose at age 28. His autopsied brain showed traumatic brain injury, chronic traumatic encephalopathy.

For Boogaard, CTE may have been one cause of his drug addiction and would have become a major neurocognitive disorder if he had lived longer. Instead, NCD may have already occurred, undiagnosed. Another hockey player said of him, "His demeanor, his personality, it just left him. He didn't have a personality anymore" (John Scott, quoted in Branch, 2011, p. B13). Obviously, senility and senescence are not synonyms for neurocognitive disorder.

Preventing Impairment

Since aging increases the rate of cognitive impairment, slowing down senescence may postpone major NCD, and ameliorating mild losses may prevent worse ones. That may have occurred in the decreasing rates of major NCD documented in England (Matthews et al., 2013).

Epigenetic research is particularly likely to lead to better prevention, because "the brain contains an epigenetic 'hotspot' with a unique potential to not only better understand its most complex functions, but also to treat its most vicious diseases" (Gräff et al., 2011, p. 603). Genes are always influential. Some are expressed, affecting development, and some are latent unless circumstances change. The reasons are epigenetic: Factors beyond the genes are crucial (Issa, 2011; Skipper, 2011).

The most important nongenetic factor is exercise. Because brain plasticity is lifelong, exercise that improves blood circulation not only prevents cognitive loss but also builds capacity and repairs damage. The benefits of exercise have been repeatedly cited in this text. Now we simply emphasize that physical exercise—even more than good nutrition and mental exercise—prevents, postpones, and slows cognitive loss of all kinds (Erickson et al., 2012; Gray et al., 2012; Lövdén et al., 2013).



(a)



(b)

Same Situation, Far Apart: Strong Legs, Long Life As this woman in a Brooklyn seniors center (a) and this man on a Greek beach (b) seem to realize, exercise that strengthens the legs is particularly beneficial for body, mind, and spirit in late adulthood.

Medication to prevent stroke also protects against neurocognitive disorders. In a Finnish study, half of a large group of older Finns were given drugs to reduce lipids in their system (primarily cholesterol). Years later, fewer of them had developed NCD than did a comparable group who were not given the drug (Solomon et al., 2010).

Avoiding specific pathogens is critical. For example, beef can be tested to ensure that it does not have BSE, condoms can protect against AIDS, syphilis can be cured with antibiotics. For most cognitive disorders, however, despite the efforts of thousands of scientists and millions of older people, no foolproof prevention or cure has been found. Avoiding toxins (lead, aluminum, copper, and pesticides) or adding supplements (hormones, aspirin, coffee, insulin, antioxidants, red wine, blueberries, and statins) have been tried as preventatives but have not proven effective in controlled, scientific research.

Thousands of scientists have sought to halt beta-amyloid production in the brain and have had some success in mice but not yet in humans. One current goal is to diagnose Alzheimer disease 10 or 15 years before the first outward signs appear, in order to prevent brain damage. That is one reason for the interest in mild neurocognitive disorders: They often (though not always) progress to major problems. If it were known why some mild losses do not lead to major ones, prevention might become found.

Among professionals, hope is replacing despair. Earlier diagnosis seems possible; many drug and lifestyle treatments are under review (Hampel et al., 2012; Lane et al., 2011). Hope comes from contemplating the success that has been achieved in combating other diseases. Heart attacks, for instance, were once the leading cause of death for middle-aged men. That is no longer the case.

As with heart disease, the first step in prevention and treatment of NCD is to improve overall health. High blood pressure, diabetes, arteriosclerosis, and emphysema all impair cognition, because they disrupt the flow of oxygen to the brain. Each type of neurocognitive disorder, each slowdown, and all chronic diseases interact, so progress in one area may reduce incidence and severity in another. A healthy diet, social interaction, and especially exercise decrease cognitive



(a)

Where to Live? People with major neurocognitive disorders cannot live alone. When 83-year-old Herb Winokar (a) developed Parkinson's and NCD, his daughter took him into her New Jersey home, with her husband, two children, an au pair, and two caregivers. Here Herb's 12-year-old grandson tries to calm him when he is agitated and wants to leave. When the Franciscan Sisters in Germany designed a home (b) for those with cognitive losses, they duplicated the layout and even the refrigerator of 50 years ago. Several dozen people (some of them volunteers) care for 27 residents. Here Nicole Gross talks with Magdalene Seufort, making Werner Tietz laugh.



impairment of every kind, affecting brain chemicals and encouraging improvement in other health habits.

Early, accurate diagnosis, years before obvious symptoms appear, leads to more effective treatment. Drugs do not cure NCD, but some slow progression. Sometimes surgery or stem cell therapy is beneficial. The U.S. Pentagon estimates that more than 200,000 U.S. soldiers who were in Iraq or Afghanistan suffered traumatic brain injury, predisposing them to major neurocognitive disorder before age 60 (Miller, 2012). Measures to remedy their brain damage may help the aged as well.

Reversible Neurocognitive Disorder?

Care improves when everyone knows that a disease is undermining intellectual capacity. Accurate diagnosis is even more crucial when memory problems do not arise from a neurocognitive disorder. Brain diseases destroy parts of the brain, but many older people are thought to be permanently “losing their minds,” when a reversible condition is at fault.

Depression and Anxiety

The most common reversible condition that is mistaken for neurocognitive disorder is depression. Normally, older people tend to be quite happy; frequent sadness or anxiety is not normal. Ongoing, untreated depression increases the risk of dementia (Y. Gao et al., 2013).

Ironically, people with untreated anxiety or depression may exaggerate minor memory losses or refuse to talk. Quite the opposite reaction occurs with early Alzheimer disease, as victims are often surprised when they cannot answer questions, or with Lewy body or frontal lobe disorders, when people talk without thinking.

Specifics provide other clues. People with neurocognitive loss might forget what they just said, heard, or did because current brain activity is impaired, but they might repeatedly describe details of something that happened long ago. The opposite may be true for emotional disorders, when memory of the past is impaired but short-term memory is not.

Nutrition

Malnutrition and dehydration can also cause symptoms that may seem like brain disease. The aging digestive system is less efficient but needs more nutrients and fewer calories. This requires new habits, less fast food, and more grocery money (which many do not have).



Some elderly people deliberately drink less because they want to avoid frequent urination, yet adequate liquid in the body is needed for cell health. Since homeostasis slows with age, older people are less likely to recognize and remedy their hunger and thirst, and thus may inadvertently impair their cognition.

Beyond the need to drink water and eat vegetables, several specific vitamins have been suggested as decreasing the rate of dementia, including anti-oxidants (C, A, E) and vitamin B-12. High levels of homocysteine (from animal fat) seem to increase dementia (Perez et al., 2012; Whalley et al., 2014). Obviously, any food that increases the risk of heart disease also increases the risk of stroke and hence vascular disease. In addition, some prescribed drugs destroy certain nutrients, although specifics require more research (Jyrkkä, et al., 2012).

Indeed, well-controlled longitudinal research on the relationship between particular aspects of nutrition and NCD has not been done. It is known, however, that people who already suffer from NCD tend to forget to eat or choose unhealthy foods, and that hastens their mental deterioration. It is also known that alcohol abuse interferes with nutrition, directly (reducing eating and hydration) and indirectly (by destroying some vitamins).

Polypharmacy

At home as well as in the hospital, most elderly people take numerous drugs—not only prescribed medications, but also over-the-counter preparations and herbal remedies—a situation known as **polypharmacy** (Hajjar et al., 2007). Excessive reliance on drugs can occur on doctor's orders as well as patient ignorance.

Unfortunately, recommended doses of many drugs are determined primarily by clinical trials with younger adults, for whom homeostasis usually eliminates excess medication (Herrera et al., 2010). When homeostasis slows down, excess may linger. In addition, most trials to test safety of a new drug exclude people who have more than one disease. That means drugs are not tested on many of the elderly who will use them.

The average elderly person in the United States sees a physician eight times a year (Schiller et al., 2012). Typically, each doctor follows “clinical practice guidelines,” which are recommendations for one specific condition. A “prescribing cascade” (when many interacting drugs are prescribed) may occur.

In one disturbing case, a doctor prescribed medication to raise his patient's blood pressure, and another doctor, noting the raised blood pressure, prescribed a drug to lower it (McLendon & Shelton, 2011–2012). Usually, doctors ask patients what medications they are taking and why, which could prevent such an error. However, people who are sick and confused may not give accurate responses.

Another problem is that people of every age forget when to take which drugs (before, during, or after meals? after dinner or at bedtime?), a problem multiplied as more drugs are prescribed (Bosworth & Ayotte, 2009). Short-term memory loss makes this worse.

Even when medications are taken as prescribed and the right dose reaches the bloodstream, drug interactions can cause confusion and memory loss. Cognitive side effects can occur with almost any drug, especially those drugs intended to reduce anxiety and depression. They often affect memory or reasoning.

Finally, following recommendations from the radio, friends, and television ads, many of the elderly try supplements, compounds, and herbal preparations that contain mind-altering toxins. Some of the elderly believe that only illegal drugs are harmful to the mind, which makes alcoholism and pill addiction harder to recognize in the elderly. For many reasons, polypharmacy can be dangerous, as the following describes.

polypharmacy Refers to a situation in which elderly people are prescribed several medications. The various side effects and interactions of those medications can result in dementia symptoms.



Although drugs, nutrition, and other measures may also be helpful. The elderly are sometimes thought to suffer from NCD when in fact they have other problems, especially depression, alcoholism, malnutrition, or polypharmacy.

>> New Cognitive Development

You have learned that most older adults maintain adequate intellectual power. Some losses—in rapid reactions, for instance—are quite manageable, and only a minority of elders suffer a major neurocognitive disorder. Beyond that, the lifespan perspective holds that gains as well as losses occur during every period.

Lifespan Link: The multidirectional characteristic of development is discussed in Chapter 1.] Are there cognitive gains in late adulthood? Yes, according to many developmentalists. New depth, enhanced creativity, and even wisdom are possible.

Erikson and Maslow

Both Erik Erikson and Abraham Maslow were particularly interested in the elderly, interviewing older people to understand their views. Erikson's final book, *Vital Involvement in Old Age* (Erikson et al., 1986), written when he was in his 90s, was based on responses from other 90-year-olds—the cohort who had been studied since they were babies in Berkeley, California.

Erikson found that in old age many people gained interest in the arts, in children, and in human experience as a whole. He observed that elders are “social witnesses,” aware of the interdependence of the generations as well as of all of human experience. His eighth stage, *integrity versus despair*, marks the time when life comes together in a “re-synthesis of all the resilience and strengths already developed” (Erikson et al., 1986, p. 40).

Maslow maintained that older adults are more likely than younger people to reach what he originally thought was the highest stage of development, **self-actualization**. Remember that Maslow rejected an age-based sequence of life, refusing to confine self-actualization to the old. However, Maslow also believed that life experience helps people move forward, so more of the old reach the final stage.

The stage of self-actualization is characterized by aesthetic, creative, philosophical, and spiritual understanding (Maslow, 1970). A self-actualized person might have a deeper spirituality than ever; might be especially appreciative of nature; or might find life more amusing, laughing often at himself or herself.

This seems characteristic of many of the elderly. As you read in Chapter 23, studies of centenarians find that they often have a deep spiritual grounding and a surprising sense of humor—surprising, that is, if one assumes that people with limited sight, poor hearing, and frequent pain have nothing to laugh about.

Learning Late in Life

Many people have tried to improve the intellectual abilities of older adults by teaching or training them in various tasks (Lustig et al., 2009; Stine-Morrow & Basak, 2011). Success has been reported in specific abilities. In one part of the Seattle Longitudinal Study, 60-year-olds who had lost some spatial understanding had five sessions of personalized training and practice. As a result, they returned to the skill level of 14 years earlier (Schaie, 2005).

Another group of researchers (Basak et al., 2008) targeted control processes. Volunteers with an average age of 69 and no signs of any cognitive disorder were



Long Past Warring Many of the oldest men in Mali, like this Imam, are revered. Unfortunately, Mali has experienced violent civil wars and two national coups in recent years, perhaps because 75 percent of the male population are under age 30 and less than 2 percent are over age 70.

self-actualization The final stage in Maslow's hierarchy of needs, characterized by aesthetic, creative, philosophical, and spiritual understanding.



Excited Neurons As you see, this nursing home in New Mexico has a large, impersonal assembly room, where some residents sit in isolation. However, that deficit may be offset for others by the energetic Activities Director (Cyndi Bolen, left), who provided Wii Sports bowling on a wide screen. At least one of the oldest-old (Mildred Secrest, right) was thrilled when she got a spare.

divided into an experimental group and a control group. Everyone took a battery of cognitive tests to measure executive function. Everyone was a video-game player.

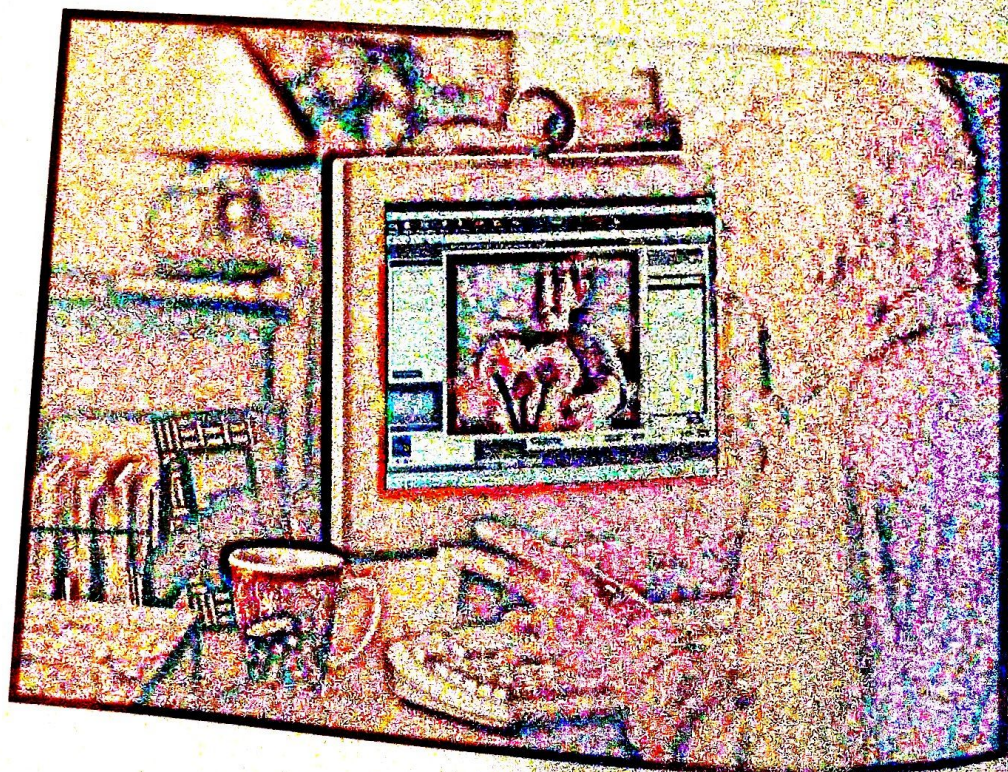
The experimental group was taught to play a video game that was preset to begin at the easiest level. After each round, they were told their score, and another round began—more challenging in pace and memory if the earlier one was too easy. The participants seemed to enjoy trying to raise their score. After 20 hours of game playing over several weeks, the cognitive tests were given again. Compared with the control group, the experimental group improved in mental activities that were not exactly the ones required by the video game.

Similar results have been found in many nations in which elders have been taught a specific skill. As a result, almost all researchers have accepted the conclusion that people younger than 80 can advance in cognition if the educational process is carefully targeted to their motivation and ability.

For instance, in one study in southern Europe people who were cognitively intact but were living in senior residences were taught memory strategies and attended motivational discussions to help them understand why and how memory was important for daily functioning. Their memory improved compared to a control group, and the improvements were still evident 6 months later (Veronica et al., 2013).

What about the oldest-old? Learning is more difficult for them, but it is still possible. The older people are, the harder it is for them to master new skills and then apply what they know (Stine-Morrow & Basak, 2011). Older adults sometimes learn cognitive strategies and skills and maintain that learning if the strategies and skills are frequently used, but they may quickly forget new learning if it is not applied (Park & Bischof, 2013). They revert back to familiar, and often inferior, cognitive patterns.

Let's return to the question of cognitive gains in late adulthood. In many nations, education programs have been created for the old, called Universities



Screen to Brain Although elders are least likely to have Internet connection at home, they may be most likely to benefit from it. Video games may improve cognition in late adulthood. Even better may be videoconferencing with a grandchild, as shown here. Mental flexibility and family joy correlate with a long and happy life.



Alaska Learning Martha Wroe (right) of Gainesville, Florida is one of 14 seniors who travelled to Alaska on an Elderhostel excursion. "I wanted an adventure," she said. Adventures in late adulthood expand cognition.

Observation Quiz Which is more likely to advance Martha's thinking, the walrus tusk or Maryann Menderhal (left), who shot the animal? (see answer, page 722)

for the Third Age in Europe and Australia, and Exploritas (formerly Elderhostel) in the United States. Classes for seniors must take into account the range of needs and motivations: Some want intellectually challenging courses and others want practical skills (Villar & Celdrán, 2012). All the research finds that, when motivated, older adults can learn.

Aesthetic Sense and Creativity

Robert Butler was a geriatrician responsible for popularizing the study of aging in the United States. He coined the word *ageism*, and wrote a book, *Why Survive: Being Old in America*, first published in 1975. Partly because his grandparents were crucial in his life, Butler understood that society needs to recognize the potential of the elderly.

Butler explained that "old age can be a time of emotional sensory awareness and enjoyment" (Butler et al., 1998, p. 65). For example, some of the elderly take up gardening, bird watching, sculpting, painting, or making music, even if they have never done so before.

Elderly Artists

A well-known example of late creative development is Anna Moses, who was a farm wife in rural New York. For most of her life, she expressed her artistic impulses by stitching quilts and embroidering in winter, when farm work was slow. At age 75, arthritis made needlework impossible, so she took to "dabbling in oil."

Four years later, three of her paintings, displayed in a local drugstore, caught the eye of a New York City art dealer who happened to be driving through town. He bought them, drove to her house, and bought 15 more.

The following year, at age 80, "Grandma Moses" had a one-woman show, receiving international recognition for her unique "primitive" style. She continued to paint, and her work "developed and changed considerably over the course of her



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RE: RODRIGO TORRES/GETTY IMAGES/CONTRAST

Exercise and the Mind Creative activity may improve the intellect, especially when it involves social activity. Both the woman in a French ceramics class (top), subsidized by the government for residents of Grenoble over age 60, and the man playing the tuba in a band in Cuba (bottom) are gaining much more than the obvious finger or lung exercise.



History of My People When they were young they were imprisoned here, in a California internment camp for Japanese-Americans. They wanted to see it again, not only for their own life review, but also to put their experiences in context for the new generation.

>> Answer to Observation Quiz (from page 721): Most likely meeting a native grandmother, not holding the tusk, will prompt her thinking. Human relationships are particularly important for many older adults.

life review An examination of one's own life and one's role in the history of human life, engaged in by many elderly people.

twenty-year career" (Cardinal, 2001). Moses died at age 101.

Other well-known artists continue to work in late adulthood, sometimes producing their best work. Michelangelo painted the awe-inspiring frescoes in the Sistine Chapel at age 75; Verdi composed the opera *Falstaff* when he was 80; Frank Lloyd Wright completed the design of New York City's Guggenheim Museum when he was 91.

In a study of extraordinarily creative people, almost none felt that their ability, their goals, or the quality of their work had been much impaired by age. The leader of that study observed, "In their seventies, eighties, and nineties, they may lack the fiery ambition of earlier years, but they are just as focused, efficient, and committed as before... perhaps more so" (Csikszentmihalyi, 1996, p. 503).

But an older artist does not need to be extraordinarily talented. Some of the elderly learn to play an instrument, and many enjoy singing. In China people gather spontaneously in public parks to sing together. The groups are intergenerational—but a disproportionate number are elderly (Wei, 2013).

Music and singing are often used to reduce anxiety in those who suffer from neurocognitive impairment, because the ability to appreciate music is preserved in the brain when other functions fail (Ueda et al., 2013). Many experts believe that creative activities—poetry and pottery, jewelry making and quilting, music and sculpture—benefit all the elderly (Flood & Phillips, 2007; Malchiodi, 2012). Artistic expression may aid social skills, resilience, and even brain health (McFadden & Basting, 2010).

The Life Review

In the **life review**, elders provide an account of their personal journey by writing or telling their story. They want others to know their history, not only their personal experiences but also those of their family, cohort, or ethnic group. According to Robert Butler:

We have been taught that this nostalgia represents living in the past and a preoccupation with self and that it is generally boring, meaningless, and time-consuming. Yet as a natural healing process it represents one of the underlying human capacities on which all psychotherapy depends. The life review should be recognized as a necessary and healthy process in daily life as well as a useful tool in the mental health care of older people.

[Butler et al., 1998, p. 91]

Hundreds of developmentalists, picking up on Butler's suggestions, have guided elderly people in self-review. Sometimes the elderly write down their thoughts, and sometimes they simply tell their story, responding to questions from the listener.

The result of the life review is almost always quite positive, especially for the person who tells the story. For instance, of 202 elderly people in the Netherlands, half were randomly assigned to a life review process. For them, depression and anxiety were markedly reduced compared to the control group (Korte et al., 2012).



Wise or Foolish? His family (in the background) is likely to think grandfather is wise, but he probably just enjoys zipping on this home-made wire.

Wisdom

It is possible that “older adults . . . understand who they are in a newly emerging stage of life, discovering the wisdom that they have to offer” (Bateson, 2011, p. 9). A massive international survey of 26 nations from every corner of the world found that most people everywhere agree that wisdom is a characteristic of the elderly (Löckenhoff et al., 2009).

Contrary to these wishes and opinions, most objective research finds that wisdom does not necessarily increase with age. Starting at age 25 or so, some adults of every age are wise, but most, even at age 80, are not (Staudinger & Glück, 2011).

An underlying research quandary is that a universal definition of wisdom is elusive: Each culture and each cohort has its own concept, with fools sometimes seeming wise (as happens in some of Shakespeare’s plays) and those who are supposed to be wise sometimes acting foolishly (provide your own examples). Older and younger adults differ in how they make decisions; one interpretation of these differences is that the older adults are wiser, but not every younger adult would agree (Worthy et al., 2011).

One summary describes wisdom as an “expert knowledge system dealing with the conduct and understanding of life” (P. B. Baltes & Smith, 2008, p. 58). Several factors just mentioned, including self-reflective honesty (as in integrity), perspective on past living (the life review), and the ability to put aside one’s personal needs (as in self-actualization), are considered part of wisdom.

If this is true, the elderly may have an advantage in developing wisdom, particularly if they have: (1) dedicated their lives to the “understanding of life,” (2) learned from their experiences, and (3) become more mature and integrated (Ardelt, 2011, p. 283). That may be why popes and Supreme Court judges are usually quite old.

As two psychologists explain:

Wisdom is one domain in which some older individuals excel. . . . [They have] a combination of psychosocial characteristics and life history factors, including openness to experience, generativity, cognitive style, contact with excellent mentors, and some exposure to structured and critical life experiences.

[P. B. Baltes & Smith, 2008, p. 60]