Late Adulthood: Cognitive Development
The Aging Brain

New brain cells

• Neurons form and dendrites grow in adulthood, particularly in the olfactory region and the hippocampus.
• New neurons provide cognitive adaptability to succeed in context of challenging and changing environments.
• Growth of brain is slow, limited, and not sufficient to restore itself to its younger state.
Senescence and the Brain

Senescence reduces production of neurotransmitters that allow a nerve impulse to jump quickly.

• Results in a brain slowdown, seen in reaction time, talking, and thinking

Brain slowdown correlates with slower walking and most other physical disabilities.

• Although transmission of impulses from the brain are disrupted with age, specifics correlate more with cognitive ability
Brain Slowdown

Brain senescence varies markedly from individual to individual.

- Suggested reasons include gender, education, experience, and elders’ assessment of whether their everyday activities are restricted by their health.
Evidence from Neuroscience

- The hypothalamus (memory) and the prefrontal cortex (planning, inhibiting unwanted responses, and coordinating thoughts) shrink faster than other areas.
- Complicated relationship among past education, current mental exercise, and intellectual functioning in late adulthood
  - Schooling may slow the rate of brain shrinkage.
  - Good health may protect the brain more than education.
  - Education strengthens inhibition, the ability to say no or keep quiet
    - This masks impairment when the prefrontal cortex shrinks.
Why does higher education and vocational status correlate with less cognitive decline?

Three hypotheses

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.

Which hypothesis do you support? Why?
Using More of the Brain

Older adults use more of their brains to solve problems.

Possible causes

- **Compensation**
  - Using one brain region is inadequate for complex thinking, so older adults automatically use more parts.
  - Intellectual output may be unimpaired, even though the process of thinking has changed.

- **Reduced brain reserves**
  - Insufficient reserves may make challenging tasks too hard.

- **Wandering minds**
  - Brain stops using a focused region for each function, inhibition fails, attention wanders, and thinking becomes diffuse.
Using More (or Less) of the Brain

Multitasking

- Older adults who were better at working memory and multitasking used their prefrontal cortex; those who were worse did not.
- Brain shrinkage interferes with multitasking more than with other cognitive challenges.
- Multitasking slows down people of every age, but older adults more so.
- Older adults usually need to concentrate on one task at a time.
One Task at a Time

![Bar graph showing percent of slowdown in dual tasks for different age groups. The graph compares walking speed and thinking & talking.]

Source: Krampe et al., 2011.
Information Processing After Age 65

Input

• Some information never reaches sensory memory in older people because the senses never detect the stimuli.
• The brain automatically fills in missed sights and sounds.
• Most older people believe they see and hear whatever is important but vital information may be distorted or lost without the person realizing it.
Information Processing After Age 65

Memory

- Stereotype threat impedes memorial processes; suspecting memory loss can impact memory
- Memory loss can be normal and pathological, but generally explicit memory loss is greater than implicit memory loss
- Source amnesia may contribute to less analysis of information when elders cannot remember origin of a fact
Prospective memory

- Involves remembering to perform a future task
- Fades notably with age
- Includes the ability to quickly shift mentally among tasks
Information Processing After Age 65

Working memory

*Brain slowdown reduces working memory.*

- Older individuals take longer to perceive and process sensations.

*Reduced working memory inhibits multitasking.*

- When older people can take their time and concentrate, their working memory seems as good as ever.
- Concentration may crowd out other mental tasks that a younger person could do simultaneously.
Information Processing After Age 65

Long-term memory

- It is difficult to get an accurate assessment of long-term memory.
  - Emotional memories encoded at one point in life tend to endure, without much loss or distortion.

Recognition

- At every age, recognition memory is better than recall.
Control processes

- Are the underlying impairment of cognition in late adulthood, especially impaired retrieval.
- Include *executive function* of the brain: Selective attention, strategic judgment, and then appropriate action.
- Shift as analysis and forethought give way to reliance on prior knowledge, general principles, and rules of thumb.
Reminding People of What They Know

Priming

• A control strategy where words or ideas are presented in order to make it easier to remember something
• With proper control processes, cognition in late adulthood can be good
• Stereotype threat can trigger anxiety, fear, and depression hurting cognition and learning potential
Output

- Gradual decline in output of primary mental abilities (e.g., verbal meaning, spatial orientation, inductive reasoning, number ability, word fluency) is normal.
- In daily life, output is usually verbal.
- Two important modifiers are health and training.
Cognitive tests

• Usual path of cognition in late adulthood as measured by psychological tests is gradual decline, at least in output

• Such tests are normed and validated via the output of younger adults; abstract, and timed
Ecological validity

• The idea that cognition should be measured in settings that are realistic and that the abilities measured should be those needed in real life

• May be key to accurately measuring cognition in the elderly

Fundamental ecological issue

• Addresses the question: What should be assessed—pure, abstract thinking or practical, contextual thought, depersonalized abilities, or everyday actions?
Neurocognitive Disorders

Ageism of words

• 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.

• Caution is advised in the use of words used to describe cognitive decline in the elderly
  • Older terms: Senile, dementia
  • DSM-5: Neurocognitive disorders (NCDs)-Either *major neurocognitive disorder* or *mild neurocognitive disorder*, depending upon the severity of symptoms
Mild and Major Impairment

Mild NCD, formerly called *mild cognitive impairment (MCI)*

- Older adults who have significant problems with memory, but who still function well at work and home
- Forgetfulness and loss of verbal fluency that often comes before the first stage of AD
- About half will become demented, but some stabilize with mild impairment and others regain their cognitive abilities

**Measuring mild loss**

- qmci; biological indicators (biomarkers); clinical judgment of professionals
Most elderly people never experience a neurocognitive disorder. Among people in their 70s, only 1% 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.)
Major and Minor Impairment

Alzheimer disease (AD)

• Most common cause of NCD, characterized by gradual deterioration of memory and personality and marked by the formation of plaques of beta-amyloid protein and tangles of tau protein in 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.
Genes and Alzheimer Disease

- AD in middle age is rare, usually caused by genes (e.g., Down syndrome), and progresses quickly.
- Most cases begin much later and many genes have some impact (e.g., SORL1 and ApoE4).
- Genetic tests for AD in late adulthood are rarely used before symptoms appear because they might evoke false fear or deceptive reassurance.
Hopeful Brains  Even the brain without symptoms (a) might eventually develop Alzheimer disease, but people with a certain dominant gene definitely will.
Prevalence of NCD

Vascular dementia (VaD)

- A form of dementia 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; also called multi-infarct dementia.

- 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 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.
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.
Prevalence of NCD: Other Dementia

Frontal lobe disorders (*frontotemporal lobar degeneration*)

- Characterized by personality changes
- Caused by deterioration of the frontal lobes and the amygdala
- Emotional and personality changes are the main symptoms
- Usually begins later
Other Disorders

**Parkinson disease**
- Does not always lead to NCD
- Starts with rigidity or tremor of the muscles as neurons that produce dopamine degenerate
- Younger adults with Parkinson disease may avoid cognitive problems for years

**Lewy body dementia**
- Named after round deposits of protein (Lewy bodies) in the neuron
- Numerous and dispersed throughout the brain
- Motor movements and cognition are impacted
- Main symptom is loss of inhibition
Prevention and Treatment

Since aging increases the rate of cognitive impairment, slowing down senescence may postpone major NCD, and ameliorating mild losses may prevent worse ones.

- Improving overall health is the first step in prevention and treatment.
- Engaging in regular physical exercise prevents, postpones, and slows cognitive loss of all kinds.
- Avoiding the pathogens is critical.
Reversible Impairment

- Accurate diagnosis is crucial when a person is wrongly thought to have NCD.
- The most common reversible cause of NCD symptoms is depression.
- Malnutrition, dehydration, brain tumors, physical illness and overmedication can cause NCD-like symptoms.
Reversible Impairment

With age, bodies become less efficient at digesting food and using its nutrients.

Polypharmacy

- When the elderly are prescribed several drugs and the side effects can cause NCD symptoms
- Some drug combinations can produce confusion and psychotic behavior
New Cognitive Development

Erikson and Maslow

- **Integrity versus despair**
  - The final stage in Erikson’s model in which older people gain interest in the arts, in children, and in human experience as a whole

- **Self-actualization**
  - The final stage in Maslow's hierarchy of needs, characterized by aesthetic, creative, philosophical, and spiritual understanding
New Cognitive Development

Learning late in life

- A variety of teaching or training tasks to improve the intellectual abilities of older adults have been investigated
- Schaie: Seattle Longitudinal Study-improvement of spatial understanding
- Basak and colleagues Video game protocol and improvement in skills related to specific executive functions
- Vranica and colleagues: Memory strategies instruction and improvement in memory functions
Aesthetic Sense and Creativity

Elderly artists with extraordinary talents did not feel their ability had been age-impaired

- Grandma Moses and paintings/age 80
- Michelangelo and Sistine Chapel/age 75
- Verdi and *Falstaff*/age 80
- Frank Lloyd Wright and Guggenheim design/age 91
Aesthetic Sense and Creativity

Life review
• An examination of one’s own part in life, which often takes the form of stories written or spoken by elderly people who want to share them with younger ones
• Results are almost always positive

Wisdom
• Expert knowledge system dealing with the conduct and understanding of life
• Life review, self-actualization, and integrity are considered parts of wisdom.
• Some elderly people are unusually wise.