

Brain Fitness

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Healthy Cognitive Aging: Secrets for staying sharp in older age

Cognitive Functioning Declines in Normal Aging

Neurodegenerative diseases like Alzheimer's produce major neurocognitive disorder (dementia) in their end clinical stages. All are caused by abnormal protein aggregation which are toxic to normal brain cells. Alzheimer's is caused by the accumulation of two abnormal proteins (beta amyloid and tau) over several decades. The increase in these proteins eventually cause severe cognitive decline (dementia). It should be noted that while these diseases progress, there is no cognitive decline; that happens only in the end stages.

As the greatest risk factor for Alzheimer's (AD) is age, AD increases with increasing age. By age 85, 47% of people have Alzheimer's pathology (but, as we shall see, not necessarily dementia). The number of persons with dementia is rising.

75% of people do not realize they can reduce the risk of dementia. Nothing has been shown to prevent Alzheimer's pathology, but there are evidence-based ways to improve and prolong brain functionality, and to reduce the probability of cognitive decline. Higher levels of lifelong experiences, such as cognitive, social and physical activities, are associated with a later onset and decreased risk of dementia

Most adults over the age of 65 will not develop dementia or even mild cognitive impairment. Although dementia and mild cognitive impairment are both common, even those who do not experience these conditions may experience subtle cognitive changes associated with aging. These normal cognitive changes are important to understand because, first, they can affect an older adult's day to day function and, second, they can help us distinguish normal from disease states. Cognitive changes are normal in the process of aging.

Different cognitive skills decline at different rates. Other important cognitive abilities decline little, if any, with age. Language and vocabulary are well retained throughout the lifespan. In fact, vocabulary continues to improve into middle to old age. Recall of general knowledge acquired at a young age and well-practiced skills like arithmetic also peak in middle age and are resistant to age-related decline. In general, these age-resistant cognitive skills are strengthened by experience. In addition, older adults often have a better overview of a situation, or better appreciation involving the impact of a single event, than younger people do, because of their greater life experience.

Overestimating the Impact of Aging?

It is unclear how much cognitive decline is purely the result of the aging of an otherwise healthy brain. Older adults in cognitive studies are more likely than young or middle-aged adults to have undetected Alzheimer's dementia, cerebral vascular dementia, and other brain diseases that are more prevalent in people over 70. In one recent long-term study of older adults, brain diseases detected at autopsy accounted for a large amount of the cognitive decline measured during the study. If individuals with undetected early-stage brain diseases are included in studies of normal aging, the amount of measured cognitive decline that is purely age-related will be exaggerated.

Certain cognitive abilities show at least a small decline with advanced age in many, but not all, healthy individuals. Although differences between the young and elderly can be shown in some cognitive areas described below, declining ability does not translate into impairment in daily activities. These changes are often subtle, and not disabling.

On one hand, there is increase, at least until people are in their 60s, for measures representing products of processing carried out in the past, such as vocabulary or general information in which the relevant acquisition occurred earlier in one's life. On the other hand, there is nearly linear decline from early adulthood on measures representing efficiency or effectiveness of processing carried out at the time of assessment in older individuals, usually involving manipulations or transformations of abstract or familiar material.

Some cognitive abilities, such as vocabulary, are resilient to brain aging and may even improve with age. Other abilities, such as conceptual reasoning, memory, and processing speed, decline gradually over time. There are significant differences among older adults in the rate of decline in some abilities, such as measures of perceptual reasoning and processing speed.

Some important longitudinal studies include the K. Warner Schaie and Sherry Willis's Seattle Longitudinal Study (n = 5676), the Whitehall Study of British Civil Servants (n = 18,000), and the Nun Study (n = 678).

The Seattle study found that reliable decline can be found for all abilities by age 74; by age 81, average decline is 1 s.d. for most abilities; we are cognitively better from age 40-65 than in our 20s for: Vocabulary, Verbal Memory, Spatial Orientation, and Inductive reasoning

The Seattle study found that after age 65:

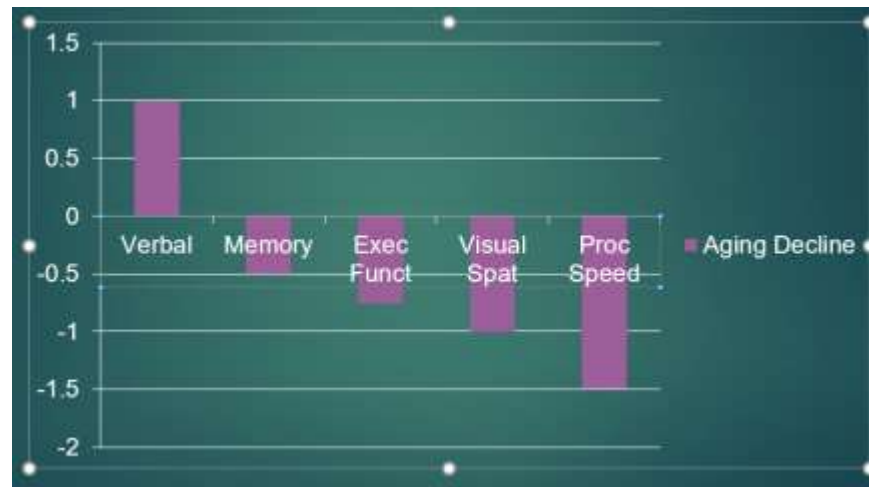
Verbal Knowledge remains intact; but there is some difficulty with name retrieval, particularly the names of those we've not seen in a while; but not in vocabulary ability.

Memory Ability = ½ s.d. decrease ↓

Spatial Ability = 1 s.d. decrease ↓ ↓

Processing speed = 1 ½ s.d. decrease ↓ ↓ ↓

Obviously the higher your IQ, the less noticeable these effects will be. The lower your IQ, the more noticeable they will be.



Higher intellectual status of spouse: spouse's cognitive ability is protective of your cognition: lower IQ spouse gets the benefit (lower risk of AD). The brain needs to be challenged and stimulated.

Whitehall conclusions: Importance of healthy lifestyles and cardiovascular risk factors - Mid-life levels of obesity, hypertension, and high cholesterol seem to be more important than at older ages. Cognitive changes can begin in the mid-40s. What is good for your heart is good for your brain.

The Nun study: Lead to the discovery of the "cognitive reserve" phenomena: that 30% of older people who have no dementia or cognitive impairment before dying have moderate-to-high Alzheimer disease in their brains (high levels of beta amyloid and tau). And that one's early brain is very important. Poor linguistic complexity in young adulthood is strongly associated with cognitive decline and AD in women in old age (How complex the language was in a one-page autobiography at age 22 on entering the nunnery predicted AD at older age. Grammatical complexity is linked to early reading.)

Normal individuals with no brain pathology can expect the following deficits as they age:

Intelligence:

"Crystallized" intelligence, i.e., knowledge or experience accumulated during one's life, remains stable with age. Crystallized intelligence refers to skills, ability, and knowledge that is overlearned, well-practiced, and familiar. Vocabulary and general knowledge are examples of crystallized abilities. Crystallized abilities remain stable or gradually improve through the sixth and seventh decades of life.

On the other hand, “fluid” intelligence or abilities, i.e., problem solving ability, not based on experience or education, tend to decline. Fluid intelligence refers to abilities involving problem-solving and reasoning about things that are less familiar and are independent of what one has learned. Fluid cognition includes a person’s innate ability to process and learn new information, solve problems, and attend to and manipulate one’s environment. Executive function, processing speed, memory, and psychomotor ability are considered fluid cognitive domains. Many fluid cognitive abilities, especially psychomotor ability and processing speed, peak in the third decade of life and then decline at an estimated rate of -0.02 standard deviations per year.

Intelligent people achieve higher levels of education. Education may protect through better cardiovascular health, a known risk factor for Alzheimer’s, since people with more education tend to eat more nutritious food, exercise more, and seek treatment for their cardiovascular disease. In one study, for every 1 standard deviation increase in IQ (15 points higher), the risk of AD went down 35%. See the Lothian study below for the importance of early higher IQ.

Processing Speed

Older individuals are cognitively slower, meaning that their brain’s processing speed, based on the health of the white matter in their brains, decreases systematically with age (3 milliseconds per decade). Aging affects the speed with which cognitive and motor processes are performed. This does not mean that the activities cannot be performed, but rather that they take longer!

Processing speed refers to the speed with which cognitive activities are performed as well as the speed of motor responses. This fluid ability begins to decline in the third decade of life and continues throughout the lifespan. Many of the cognitive changes reported in healthy older adults are the result of slowed processing speed (how fast you can name or remember something, do math, etc.). Processing speed depends on the integrity of the brain’s white matter.

So, the most consistent change in normal older people is cognitive slowing. For example, on a writing task in which people were asked to substitute as quickly as possible symbols for numbers, 20-year-olds performed the task almost 75 percent faster on average than 75-year olds. Age-related slowing is also evident on certain attentional tasks, such as trying to grasp a telephone number when someone rattles it off quickly; or listening to a British TV detective series. Overall, cognitive slowing is thought to be a contributing factor in elderly people’s higher rate of automobile accidents per miles driven. In this situation, an age-related decline in information-processing speed tends to handicap the older adult.

Attention

Attention is like a football team: you need quarterback for focus & a defensive line against life's distractions. As we get older, we lose our defensive line. Older people can pay attention, but have more difficulty inhibiting distractions. Older people get age-activated "ADD".

Attention refers to the ability to concentrate and focus on specific stimuli. Simple or focused attention such as the ability to attend to a television program tends to be preserved in older age. A more noticeable age effect is seen on more complex attention tasks, such as selective and divided attention. Selective attention is the ability to focus on specific information in the environment while ignoring irrelevant information. Selective attention is important for tasks such as engaging in a conversation in a noisy environment or driving a car. Divided attention is the ability to focus on multiple tasks simultaneously, such as talking on the phone while preparing a meal. Age hinders attention, particularly when it is necessary to multitask. When switching from one task to another, the elderly have more difficulty paying attention to multiple lanes of traffic, for example, or noticing if someone is about to step off a curb at a busy intersection.

Processing information rapidly and dividing attention effectively are cognitive skills that peak in young adulthood. The ability to keep multiple pieces of information in mind at the same time is another skill that peaks around ages 18 to 20 and becomes more difficult thereafter. Every time you mentally calculate a tip in a restaurant, you use an information processing skill called "working memory.". Older adults also perform worse than younger adults on tasks involving working memory, which refers to the ability to momentarily hold information in memory while simultaneously manipulating that information. For example, older adults may have difficulty ordering a string of letters and numbers in the correct alphanumeric sequence or calculating a tip on a restaurant bill. In the clinic, we test working memory by asking people to recite backward a string of numbers that we have just read to them. This task requires working memory because the numbers need to be held in mind long enough to rearrange them

Memory

One of the most common cognitive complaints among older adults is a self-perceived change in their memory. Indeed, as a group, older adults do not perform as well as younger adults on a variety of learning and memory tests. Age-related memory changes may be related to slowed processing speed, reduced ability to ignore irrelevant information, and decreased use of strategies to improve learning and memory. While declines in semantic (fund of knowledge, word usage) and episodic (personal) memory occur with normal aging, the timing of these declines is different. Episodic memory shows lifelong declines while semantic/word meaning memory tends to increase with healthy aging and then shows late life decline. Unlike declarative conscious memory, behavioral memory (nonconscious memory: how to do things; riding a bike, playing piano, typing) remains unchanged across the lifespan.

Remote memory or recall of past events that have been stored over many years remains relatively preserved in old age. Recent memory or the formation of new memories, however, is more vulnerable to aging. The ability to recall new information, such as reading material, peaks early and gradually becomes more challenging after age 40, particularly for visual material. Studies show that by age 70 the amount of information recalled 30 minutes after hearing a story once is about 75 percent of the amount remembered by an 18-year old. Recognizing information from the story is easier than remembering it without any cues, and this ability is usually well retained throughout life. In other words, older adults are less likely than young adults to freely recall most of the information from a recently read news article, but they may be just as good at recognizing the content if someone talks about it.

Memory can also be broken down into different stages. Acquisition is the ability to encode new information into memory. Rate of acquisition declines across the lifespan. However, retention of information that is successfully learned is preserved in cognitively healthy older adults. Declines also occur in memory retrieval, which is the ability to access newly learned information.

For 1 learning trial of 16 new words: 12 items retrieved at age 20; 7 items at age 80. We remember two fewer words every decade past age 40. When asked what they typically forget, study participants noted that they normally forget: telephone numbers 58%; people's names 48%; where their car is parked 32%; and where the car keys are 31%.

Prospective memory (remembering a future intention) is a frontal lobe of the brain mediated function. It is the best single predictor of the ability to live independently (and of pilot errors in plane crashes).

A memory glitch does not mean you have a memory disorder. Most memory glitches are attentional glitches; we were not paying good enough attention to encode the memory (going to another room and not recalling why we went there). Most normal individuals will have temporary difficulty retrieving old information at times, but no trouble learning new information, and cueing always helps recognition. The more you do not use information or names, the harder they will become to recall. How quickly you can recall something will depend on your processing speed. Many people have the experience of not being able to recall an actor's name in a movie they just viewed; and then suddenly remembering the name hours later. People with dementia have no ability to learn any new information. Cueing does not help their recall.

Language

Vocabulary stays relatively intact into old age. Names, proper nouns, and rarely used words are the first to go. Inability to come up with a name is not correlated with memory loss.

Overall language ability remains intact with aging. Vocabulary remains stable and even improves over time. Common changes have to do with word retrieval or the process of getting words out. It takes longer and is more difficult to find the words one wants when engaged in conversation or trying to recall names of people and objects. The information is not lost but it is more difficult to retrieve.

Visual confrontation naming, or the ability to see a common object and name it, remains about the same until age 70, and then declines in subsequent years. Verbal fluency, which is the ability to perform a word search and generate words for a certain category (e.g., letters, animal names) in a certain amount of time, also shows decline with aging. Recalling a familiar person's name or a word during conversation commonly becomes harder for adults after age 70. Although this type of word-finding involves memory, the problem lies in accessing the word, even though it exists in the person's knowledge or vocabulary. Sometimes this problem manifests as a "tip of the tongue" experience—you feel close to recalling the word and may even know that it begins with a given letter. If someone else says the name or word, you easily recognize it. This problem is particularly frustrating because mustering effort to force recollection of the word is likely not to help. The word is apt to pop into mind later when you are going about another activity.

Most of us, particularly as we get older, have had the experience of meeting someone new and a minute later not being able to recall their name. Although usually assumed to be a memory failure, this is a failure to fully attend to the name because one is distracted by the broader social interaction, so that the name is not strongly registered in memory. (The trick here is to repeat the name aloud as soon as you hear it, as a confirmation, and then repeat it to yourself silently a couple of more times within a few minutes.)

Visuospatial Abilities/Construction

Visual construction skills, which involves the ability to put together individual parts to make a coherent whole (for example, assembling furniture from a box of parts) declines over time. In contrast, visuospatial abilities remain intact. These abilities include object perception, the ability to recognize familiar objects such as household items or faces, and spatial perception, the ability to appreciate the physical location of objects either alone or in relation to other objects.

Visual perceptual abilities, principally the ability to understand spatial relationships, also show decline with age, especially after age 80. This weakness causes another driving-related problem, such as not knowing how far away a curb is or how much to turn to

parallel-park a car. Visual scanning ability also can diminish so that, for example, it becomes more difficult to see a misplaced object among other items.

Executive Functioning

Traditional ways of approaching solutions are maintained in older persons. Problems that have not been encountered during your life may take extra time to figure out.

While Fluid IQ (problem solving) declines earlier, experiential knowledge declines only after late 70s. In contrast to performance on fluid IQ measures, middle-aged adults performed as well as or better than young adults on nearly all specific domain-knowledge tests. In old age, be prepared to know more than younger people, but not to be as fast in working out new stuff quickly.

Executive functioning refers to capacities that allow a person to successfully engage in independent, appropriate, purposive, and self-serving behavior. This includes a wide range of cognitive abilities such as the ability to self-monitor, plan, organize, reason, be mentally flexible, and problem-solve. This includes higher-level skills, such as conceptualizing a problem, making appropriate decisions, and planning and carrying out effective actions. Research has shown that concept formation, abstraction, and mental flexibility decline with age, especially after age 70, as older adults tend to think more concretely than younger adults.

Aging also negatively affects response inhibition, which is the ability to inhibit an automatic response in favor of producing a novel response. Executive abilities requiring a speeded motor component are particularly susceptible to age effects. The Whitehall II study also found declines in inductive reasoning, as measured by verbal and mathematic reasoning tasks, beginning around age 45. Reasoning with unfamiliar material also declines with age. Other types of executive function, such as the ability to appreciate similarities, describe the meaning of proverbs, and reason about familiar material, remain stable throughout life.

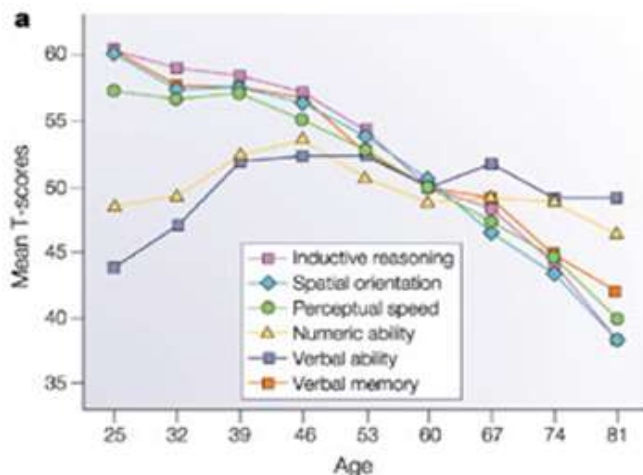
Mentalizing (theory of mind) has been defined as the ability to understand the mental state or intentions of others. A recent study using functional MRI (fMRI) confirmed prior studies showing that older adults have decreased mentalizing capacity.

Older adults tend to be slower in conceptualizing problems and less ready to change strategies when circumstances shift. In one well-known study involving decision making, approximately one-third of older adults did poorly compared to younger adults. These same older participants also were more fooled by deceptive advertising in another experiment. Findings from studies like these give a possible explanation of why some older adults are at greater risk of falling prey to fraud. Yet for many older adults, difficulty thinking through problems and mental flexibility may not be noticeable until the 80s or beyond.

Executive functioning deficit can be independent of memory deficit. Executive dysfunction is associated with functional decline and an increased need for care. Executive deficits correlate with decline in independent functioning (inability to use phone, letter, finances, meal prep). If executive functioning is impaired an individual: cannot live independently; they will have money management difficulties and medication management difficulties. One can live by oneself with some memory difficulties, but not with significant executive functioning difficulty.

Summary of cognitive changes:

Seattle Longitudinal Study: Verbal Ability ok vs. All other cognitive abilities having mild to moderate decline; but these individuals can functional independently. This is not major dementia which makes it utterly impossible to function independently.



Brain Changes with normal aging

Grey matter volume begins to decrease after age 20. The amount of atrophy is most prominent in the prefrontal cortex. Age-related changes in the temporal lobes are more moderate and involve decreases in the volume of the hippocampus (memory central). Beta-amyloid is found in the cortex of up to 30% of cognitively normal adults. Grey matter volume decline in older adults is best explained not by death of the neurons themselves but by decrease in their size and the number of connections between them. This reduction in synaptic density is well documented in older adults

White matter changes

Each neuron has a cell body and several processes called dendrites that extend in many directions toward other neurons for receiving signals. Think of a tree limb with many branches. During aging, the size and complexity and efficiency of this “arborization” decreases, making communication between cells less effective. Each

neuron also has an axon that transmits signals from one cell to another; these axons make up the “white matter” in the brain. Damage to white matter tracts with aging contributes to decreased brain size. These and other structural brain changes associated with aging correspond to age-related differences in performance across cognitive tasks. For example, white matter deterioration in the front of the brain has been associated with slower information-processing speed and more difficulty recalling information. Having less white matter damage is associated with higher general cognitive ability and faster processing speed in one’s 70s.

White matter volume decreases are much greater than grey matter volume decreases with increasing age. In neurologically normal subjects, there was a 16–20% decrease in white matter volume in subjects over 70 years old. White matter integrity declines with increasing age. White matter changes affect processing speed and executive functioning.

The atrophy rate of the hippocampus (HC) is 2–3% per decade. The hippocampus counts among the few brain regions with the ability to generate new neurons (neurogenesis) throughout the lifespan. Healthy brains contain newborn neurons, but the number declines steadily with age. Between the ages of 40 and 70, the number of fresh neurons fell from about 40,000 to 30,000 per cubic millimeter. The gradual reduction in new brain cells appears to go hand-in-hand with the cognitive decline that comes with old age. It suggests that in middle age about 300 fewer neurons per cubic millimeter are made in the dentate gyrus with each advancing year. In the earliest stages of AD, their brains only had between half and three quarters as many fresh neurons as the healthy ones. The number of cells you detect in healthy subjects is always higher than the number detected in Alzheimer’s disease patients, regardless of their age.

In animal models, physical activity and higher cardiorespiratory fitness levels are associated with larger hippocampal volumes in late adulthood. Regular walking replaces this 2% HC loss.

Historically, scientists have assumed that when healthy older people complained of cognitive deficits, their cortex shrinkage was to blame, or at least reflected a neurodegenerative process. But the people with a relatively thinner cortex in old age also had a lower IQ both as adults and in childhood. That suggests that those who appear to be losing brain mass along with their cognitive abilities may simply have started out with less gray matter to begin with.

With aging come increased risks for vascular disease for many people. High blood pressure, high levels of the good cholesterol (HDL), high triglyceride levels (a type of fat found in the blood), obesity, and diabetes increase risk of stroke and white matter disease. Higher education and bilingualism appears to lower the impact of stroke on cognitive functioning. Keeping the brain healthy through good nutrition and physical activity is important to reduce the risk of cognitive decline associated with vascular

disease. A healthy diet includes limiting the intake of sugar and saturated fats, particularly trans fats.

During normal aging, changes occur in the pattern of stimulation of neural networks, causing increased activation in some areas and decreased activation in others. Studies reveal that when an elderly person performs a cognitive task at the same level as that of a young adult, more areas of the former's frontal brain regions "light up," suggesting more brain activity is needed to maintain cognitive performance. Older individuals use more areas than young people on tasks of same difficulty level.

Practical implications of age-related cognitive decline

All of the above normal age-related cognitive change does not impair a person's ability to perform normal daily activities. If an older adult develops functional impairments, even with complicated tasks such as managing finances or medications, it is prudent to pursue a workup for dementia if there is no other obvious explanation for these difficulties, such as a reaction to a new medication, a new medical illness, or a vision problem. However, studies show that normal cognitive aging can result in subtle declines in complex functional abilities, such as the ability to drive.

Driving

Seniors have more fatal crashes per miles driven than almost any other age group (due to sensory & processing speed declines). Older adults are at higher risk for motor vehicle accidents compared to younger drivers. In many cases this is due to cognitive impairment (MCI or dementia), other neurologic or musculoskeletal disorders, other medical illnesses, vision problems, or medications. Unfortunately, even older adults who manage to avoid all these challenges may still become unsafe drivers due to normal cognitive aging, which can cause small decrements in the multiple cognitive domains needed for driving. These domains include visual attention/processing (the ability to select visual stimuli based on spatial location), visual perception (the ability to accurately perceive and interpret what is seen), executive function, and memory. Interestingly, tests of visual processing speed, such as the Useful Field of View® test can predict at-fault motor-vehicle crashes in older adults. Despite these observations, many older adults with normal cognition do not experience a decline in driving ability or are able to effectively limit their driving to avoid high risk situations. A DMV exam may be the best measure of this.

Avoiding Cognitive Decline: "Successful" Cognitive Aging

Factors Affecting Cognitive Aging

There is significant variability in age-related cognitive changes from individual to

individual. Genetics, medical illness, psychological factors, and sensory deficits such as vision and hearing impairment certainly can also accelerate age-related cognitive decline. All the above abilities can be affected by factors that change the efficiency with which older adults process information. These include:

- Medications which may produce side effects such as drowsiness and mental dullness;
- Sensory changes which can interfere with the processing of information (e.g., loss of hearing which can affect whether someone's name is heard when introduced; visual loss requiring glasses or medication);
- Health related changes such as arthritis and pain which can affect cognitive areas such as concentration and processing speed; and
- Changes in mood such as depression and anxiety which can alter one's motivation to learn new information and to apply active strategies.

So, the natural question that follows, of course, is whether there are certain environmental or behavioral factors that can prevent or delay age-associated cognitive declines.

Use it or lose it: reduced everyday experiences and activity patterns may result in disuse and consequent atrophy of cognitive processes and skills as well as of the brain (a view captured in the term 'use it or lose it'). Without use, brain cells are signaled that they are no longer needed, resulting in dendritic atrophy and synaptic connection weakening. There can be reduced brain activity from negative learning (loss of skills) due to non-practice of normal cognitive or motor skills. Studies indicate that those who do not retire have less dementia.

Lifestyle-Cognition Hypothesis

The lifestyle-cognition hypothesis holds that maintaining an active lifestyle and engaging in certain activities during one's life may help prevent age-associated cognitive decline and dementia. Support for this hypothesis is because older adults with high cognitive function seem to participate in certain activities with greater frequency than older adults with low cognitive function. This raises the question of whether certain activities may delay or prevent cognitive decline.

Activities associated with higher cognitive function in older adults

Cognitive Reserve

One theory for how certain activities may prevent age-associated cognitive decline is the theory of cognitive reserve (CR). The cognitive reserve hypothesis posits that some individuals have a greater ability to withstand pathologic changes to the brain, such as the accumulation of amyloid protein due to greater "brain reserve". The concept of brain

reserve was established to account for the observation that a given degree of neurodegenerative pathology may result in varying degrees of symptoms in different individuals. CR describes resilience against these brain changes.

The Nun Study led to the concept of Cognitive Reserve: some people can tolerate brain damage for a longer time without showing intellectual signs of damage. Cognitive reserve represents the difference between amount of brain pathology & the actual cognitive function in an individual.

At this point, three important concepts have emerged, namely brain reserve (BR) and cognitive reserve (CR). BR points to the idea that individuals with more neurobiological capital, such as more synapses, more dendrites, or neurons, do better in the face of age-related or pathologic brain changes; you have more neurobiological capital. In the landmark article by Blessed et al. in 1968, the authors noted that six subjects had a dementia score near 0 but a high amyloid- β ($A\beta$) plaque count. In the context of normal ageing, Brain reserve can be considered the status of your brain 'hardware' such as brain volume and white matter integrity. Finally, CR focuses on the idea that there are individual differences in adaptability (i.e. flexibility, efficiency, capacity, compensation) of functional brain processes that allow some people to cope better than others with age- and disease-related brain change. There is a reduced risk of dementia in individuals with higher educational or occupational attainment, premorbid IQ and engagement in leisure activities.

Predictors of cognitive reserve:

Studies have found that the best predictors of the amount of CR people have include: Having a bigger brain/head circumference (more connections), Higher IQ, Higher vocabulary level, Higher education (having a college degree reduces cognitive decline by up to a decade; also you live longer), Occupational complexity (work that involves complex thinking and social interaction), Higher Social Economic Status (those with more money have better health care), Regular cognitive activity (reading, crossword puzzles), Higher literacy, More social engagement, Early-age and later-age physical activity, and Better cardiovascular status

Fred Astaire said "Old age is like everything else. To make a success of it, you've got to start young."

Lothian Study of Scotland: all of Scotland's 1921-born population = 87,498 eleven-year-old children were given the same IQ test in both 1932 and 1942. These individuals were eventually repeatedly cognitively tested in their old age. The major finding of this study is that the brain you are born with really counts. Intellectual ability appears to stay stable during one's life. 50% of the variance at age 77 is explained by your IQ at age 11. We need to thank our parents for our genes and benevolent early environment and educational drive. Tendency, but not determination, for smart kids to become smart older adults. Low early-life cognitive ability is an early marker of dementia risk in later

life. They also found confirmation for “Mens sana in corpore sano”: physical fitness predicts better cognition, less brain atrophy, & better white matter connections in old age. It appears that smarter kids become smarter adults who engage in brain saving kinds of adult behaviors in their life and end up with less cognitive decline. But remember that lifestyle matters: those who did not smoke, were physically fit, bilingual, and more educated had higher IQ scores at age 77 than their early life scores would have predicted.

There were similar findings from the 1960’s Project Talent testing of high school students. Higher scores in adolescence predicted a lower incidence of Alzheimer’s and related dementias in their 60s and 70s. And the Nun Study found that the linguistic complexity evident in a 1-page autobiography at age 22 predicted who went on to Alzheimer’s at age 70. A 2015 study found that low childhood school performance increased dementia risk. Starting out with a better brain counts in old age. It is possible that being blessed with the right genes accounted for much of this benefit, although little is known about what genes might be involved.

This is not to say that those with a lot of cognitive reserve will never get Alzheimer’s! Obviously, they do. The point of having cognitive reserve is not to prevent Alzheimer’s, in the sense of “it’ll never happen”. When we talk about “preventing” Alzheimer’s, we’re really talking about delaying it. The trick is to delay it so much that you’re dead before it happens! So, cognitive reserve is desirable because it protects you against the damage that may be occurring in your brain. If you’re lucky, it’ll protect you long enough for you to die first before getting dementia.

Once CR has been used up, the rate of pathological decline and death is more rapid in individuals with high cognitive reserve than those with low reserve.

Cognitive Retraining

Researchers have demonstrated that subjects can be trained to do better on cognitive testing, and that these improvements can be maintained for years. 65% of participants in a cognitive training program (ACTIVE study) showed significant improvement, and 40% of those who had declined significantly over 14 years were returned to their earlier (pre-decline) level of cognitive functioning. These training gains were retained over seven years.

Even more impressive, in the ACTIVE trial, a randomized, multicenter trial involving cognitively normal older adults, cognitive training resulted in less decline in self-reported ability to perform IADL compared to controls after five years. Cognitive training in this study consisted of ten one-hour sessions teaching subjects strategies to improve memory, reasoning, and speed of processing. A meta-analysis of speed of processing training studies supports the idea that cognitive training can have real effects on cognitively normal subjects’ ability to perform activities of daily living.

Risk Factors for Cognitive Decline

- ▶ Age is the greatest risk factor: Prevalence of dementia: 1% in 60-64; doubles every 5 years; 35-40% in those 85+
- ▶ Vascular disease is the largest risk factor for dementia after age: This includes high blood pressure, cholesterol, diabetes, smoking, obesity, & heart disease; 80% of those with AD have vascular disease; There is very strong evidence for a relationship between midlife cardiovascular risk factor status and the odds of having beta amyloid deposition in the brain; cardiovascular risk modification needs to start in midlife to confer maximum benefits on late-life cognition
- ▶ Being Female: 2/3rds of AD patients are women; they have a more virulent form of AD, which is independent of being older; men have greater CVA risk
- ▶ Major Traumatic Brain Injury
- ▶ Reduced cognitive and physical activity throughout life

Incidence of dementia has declined gradually over the past 40 years in higher income developed nations, due to better education and improved cardiovascular health. These incidence declines will be overwhelmed by increases in dementia brought on by population aging and negative health trends such as diabetes and obesity. Alzheimer's is expected to triple by 2050.

All of these risk factors need to be addressed or treated to have good brain fitness.

The Question: Are there medications that prevent major neurocognitive disorders like Alzheimer's disease? **The Verdict:** There are no major NCD disease prevention medications. But...there are major NCD modifying behaviors. All of the following suggestions are better if started earlier, but research indicates that starting them at any age is a positive move.

Neuroprotective Lifestyles: 26 Tips for Keeping Your Brain Healthy

A previous view was that as we age, brain cells inevitably die off and are not replaced. This concept led to the belief that nothing could be done to alter the inevitable. We now know that certain interventions can preserve and sharpen cognitive processes.

The majority of these tips are based on epidemiological studies that were observational & correlational in nature. Only 2 tips are based on RTC (randomized control trial studies which prove causation) studies. In the case of activities, there is the "which came first, the chicken or the egg" problem with many studies of this type: did a person engage in a particular activity that *prevented* them from developing cognitive decline, or was the

person able to engage in that activity *because* they did not experience cognitive decline?

The FINGER study is the first large-scale, longer-term RCT study to assess a multitarget approach to prevent cognitive decline in at-risk elderly people. Over a two-year period, they received nutritional guidance, physical exercise, cognitive training, social activities, and management of heart health risk factors (vs. the control group which received just regular health advice);

There were significant positive intervention effects on the outcome (overall cognition, executive functioning and processing speed, complex memory tasks), and other secondary outcomes (body mass index, dietary habits, and physical activity). Outcomes were 25% to 150% better in the intervention group. A seven-year study is now in progress.

The follow tips are based on small gains, not magic bullets: Effect sizes of findings indicate how much of a gain each health behavior gives you. Most are small effects. Each behavior may contribute only a little, but the total is really important. Play the numbers; the more, the better; 4 asterisks (****) indicate tips for behaviors to seriously avoid or to seriously engage in.

Strive for a healthy middle age. Cardiovascular deficits and obesity in middle age have long term cognitive consequences.

Maintaining Good Health: Regular visits to the doctor are critical to make sure that medical conditions which can themselves impair thinking are under good control. In addition, possible interactions among medications should be evaluated by letting your physician know all the medications you are taking, even if not prescribed by that doctor. And if you have cardiovascular issues, i.e. high blood pressure, get them treated.

The 5 habits for living longer: not smoking, maintain low body mass index (18-25), at least 30 minutes or more per day of moderate physical activity, moderate alcohol intake (1 per day for women, 2 for men), and a healthy diet.

Lancet 2018 Recommendations: If we do the following, we can decrease dementia by 30%: Active treatment of hypertension starting in middle age; Increase childhood education; Exercise; Social engagement; Stop smoking; Reduce hearing loss; Reduce diabetes and obesity; and Treat depression

Tip #1: Protect your head! Significant blows to the brain increase the odds of Major NCD years later. Falls are the leading cause of loss of independence in older individuals.

Tip #2: Protect your heart: Maintain excellent cardiovascular health (e.g., blood pressure, cholesterol levels) or treat all cardiovascular problems. What's good for the heart is good for the brain! Remember that there are 400 miles of blood vessels in

human brain. Take your heart meds, esp. blood pressure meds (HTN increases beta amyloid load). Exercise! Get routine medical care. Illnesses in your body affect your brain's ability to function optimally.

Tip #3: Do not Smoke: **** Quit smoking: Smoking is a lethal behavior. Smokers are 2 to 4 times more likely to develop heart disease, stroke, and dementia

Tip #4: Stay at a normal weight: Midlife obesity accounts for 7 percent of Alzheimer's cases. Obesity is correlated with stroke, dementia, and physical inactivity. But maintain a healthy weight in old age, since frailty is a major risk.

Tip #5: Read more! Regular reading makes you more intelligent: Reading is a brain workout: It lowers mental decline; Reading can make you more empathetic. Increases theory of mind (ability to understand intentions of others). Those who are highly literate are 2.5 times less likely to develop dementia; Reading may reduce stress by as much as 68%; read to your kids and grandkids (40% of frequent readers ages six through 10 were read to out loud at home); Helps to improve & maintain memory function.

Tip #6: Take Vitamin D or get Sun: Low Vitamin D in older individuals increases cognitive decline. Older need 1000 IUs/day (eat with a fat); or eat fish regularly. In San Francisco, 1-5 minutes at noon in summer; 20-30 minutes if dark skinned; double that in winter.

Tip #7: Drink Coffee: People who drink coffee have: 36% less strokes; less heart disease; 20% reduced risk of NCD/dementia (reducing inflammation & beta amyloid); reduced cancer risk (50% less recurrent breast cancer, prostate cancer, 72% less liver cancer); lower risk of liver disease; lower type 2 diabetes (21-33% less); appears to protect against depression (15% less), Parkinson's (25% less); More muscle force; Live longer (10% less mortality); Not for: pregnant women, those with sleep problems; It didn't matter if the brew was drip grind, decaffeinated or even lowly instant.

Tip #8: Brush and Floss: Gingival inflammation in elderly is associated with cognitive decline. Periodontal disease before age 35 quadrupled the odds of Major NCD years later.

Tip #9: Keep Intellectually stimulated: Studies have found that engaging in challenging cognitive tasks can protect against age-related declines in thinking and the risk of developing Alzheimer's disease. Keep doing the activities that challenge you and you enjoy for as long as possible. Trying new activities may be a great way to challenge your brain to make new brain connections. Intellectually engaging activities such as puzzles, discussion groups, reading, using the computer, playing bridge, playing board games, playing musical instruments, and attending adult education courses or other activities (going to plays, lectures, etc.) that are complicated enough to involve your mind but don't add stress to your life are great examples. Stay curious. You need to keep oneself stimulated through such activities. Google! Use the Internet. A lower incidence of dementia has been reported in subjects with higher education by most

epidemiological studies. But remember that some undereducated & under employed individuals (say due to familial poverty or lack of opportunity) may have higher intellectual ability than is evident.

Tip #10: Get Enough Sleep: 7+ hours; The brain during sleep removes beta amyloid and consolidates memory. We sleep to learn. Shorter sleep duration and poorer sleep quality are associated with greater A β burden. Sleep apnea increases stroke, cancer, Major NCD & death risk. Get it treated.

Tip #11: 15 minutes of laughter and smiling per day: Laughter & smiling are good for the heart and longevity. Smilers lived 7 years longer.

Tip #12: De-stress! Chronic stress increases risk of Major NCD. Increases levels of “stress hormones” (cortisol). High cortisol levels kill hippocampal cells. Researchers have found that high stress levels impair learning and memory in both animals and humans. Strategies to reduce stress such as exercise may be beneficial. Meditate! (associated with longer telomeres). People who meditate regularly have less cognitive decline and brain shrinkage.

Tip #13: Use Active Memory Strategies: There is evidence that some of the difficulties in storing new memories are because older persons do not spontaneously use good strategies to encode this information. When they do, age differences are lessened. In addition, older adults demonstrate good recognition of new information when they are helped with cues to jog their memory. Strategies that can be helpful to facilitate memory include following a routine (e.g., always putting one’s keys in the same place), using external techniques (e.g., a calendar, a pill box, smart phone reminders), and taking more time to actively process new information (e.g., when introduced to someone, pay extra attention and try to come up with an association to recall that person’s name & repeat their name). Spaced repetition is the single most powerful method for remembering material (Recall from memory today, tomorrow, in 1 week, in 1 month, etc.).

Tip #14: Treat Depression: Chronic depression is a risk factor for Major NCD. Turns off neurogenesis in the hippocampus. All anti-depression TX (either medication or Cognitive Behavioral Therapy or ECT) turns on neurogenesis and reduces risk of Major NCD. Antidepressants increase hippocampal volume.

Most Important Tip #15: **** Exercise: Exercise is the single most powerful and best way to reduce the risk of cognitive decline. Not enough physical activity is the number one preventable factor that contributes to Alzheimer’s cases. Aerobic exercise keeps your heart fit and increases the size of the hippocampus. Physical activity aids in reducing the risk of myriad diseases, including obesity, type 2 diabetes, cardiovascular disease, dementia, and 8 forms of cancer (bladder, breast, colon, endometrium, esophagus, kidney, lung, and stomach). Physical activity improves sleep and physical function, prevents injury from falls, and is beneficial as an adjunct to pain management. It improves mood and reduces anxiety. It lowers death rate by 33%. Exercise increases

neurogenesis. Exercise reduces dementia risk by 40%; yet only 26% of people exercise. Recommendation by the American Heart Association: 150 minutes of moderate-intensity aerobic exercise. Too much sitting, like smoking, increases the risk of heart disease, diabetes, obesity, cancer, depression, premature death, faster cognitive decline, and thinning in memory regions of the brain. Exercise facilitates oxygen and growth factors in the brain and helps modulate the brain's immune responses.

Tip #16: Drink a little Alcohol? Many epidemiological studies: Drinking one drink per day correlates with positive health outcomes. Drinking more increases heart disease. Alcohol use in any amount increases cancer risk. If you drink 5 drinks in 2 hours on any day of the week, you are alcoholic! This tip is a possible statistical confound because the use of alcohol correlates with higher incomes, higher education levels, lower rates of smoking, lower rates of mental illness and better access to health care. Which means that it may be one of these other variables that accounts for alcohol's effect. Lothian study believes it is a confound. Heavy alcohol consumption is a major risk factor for all types of dementia.

Tip #17: Socialize: Having social contacts produces longer life & less cognitive decline. Build social support networks to reduce stress, challenge your brain and share the aging process with other people who are experiencing the same changes and joys of entering the latter years of life. Social relationships are good for us & loneliness kills – the more social are happier, healthier, and live longer. It is the opposite for the lonely. Loneliness kills: isolation is toxic (less happy, health declines earlier in midlife, brain declines sooner, and you die sooner); loneliness is correlated with increased dementia risk, probably of cardiovascular causation. Numerous studies have shown that the level of social engagement, such as the size of a person's social network or frequency of contacts, promotes cognitive health or reduces the risk of dementia.

Tip #18: Stay Cognitively Active: Risk of major NCD is lower with more educational activities, more mentally stimulating activities and more leisure activities. Lower linguistic, cognitive or mental abilities have been associated with heavier neurodegenerative pathology burden at autopsy, poorer cognitive function in midlife, faster rates of cognitive decline and higher dementia rates in later life.

Tip #19: Dance: There is a significantly reduced risk of dementia in older adults who dance frequently.

Tip #20: Play a Musical Instrument: 10 years of musical experience = better nonverbal memory, naming, and executive functioning in advanced age.

Tip #21: Maintain a healthy diet: You are what you eat. Eat like a Greek or Swede. Plan your meals around your vegetables and then fill in with other foods. Otherwise, as a general plan, eat a variety of foods as close to their natural state as possible. A diet rich in fruits and vegetables containing antioxidants such as blueberries, strawberries, and broccoli as well as certain fats such as olive oil may be neuroprotective. Use the

Mediterranean diet: high plant foods; high intake of olive/vegetable oil; low intake of saturated fat, butter; moderate intake of fish and poultry twice a week; limit red meat to no more than a few times a month; low dairy products; using herbs and spices instead of salt to flavor foods; wine in moderation, normally with meals; The Mediterranean diet is associated with reduced risk of neurodegenerative disease by ~20%. Eat a little dark chocolate: Chocolate, grape seeds, red wine, cocoa, and coffee are major dietary flavonoids. Makes arteries more relaxed and flexible. But note that there is a correlation between depression and increased chocolate consumption.

Tip #22: Eat fish: Fish twice a week is better at reducing heart attacks & strokes than dietary supplements of Omega 3 fish oil.

Tip #23: Keep learning. But remember that brain training computer products are unproven (except for the ACTIVE study). Posit Science has one of the few computer programs that have definite positive research results (Useful Field of View program (DoubleDecision game)). Brain-training programs do indeed produce short-term, highly specific improvements in the task at hand, but most do not produce generalized improvements to overall intelligence, memory, attention, or other cognitive ability. Cannot repair or restore neurons. Transfer of computerized training is still controversial and being researched. Not a disease modifying intervention. CT is not a substitute for exercise, cardio medications, or socializing. Every hour spent alone at the computer is an hour not spent hiking, learning a new language, inventing a new recipe, or playing with your grandkids.

Tip #24: Be Passionate! Have a purpose in your life. Greater purpose in life is associated with: 2x reduced risk of AD and MCI; exhibit better cognitive function; less disability; have better mental health; live longer.

Tip #25: Volunteering is Win-Win: You live longer. Volunteering reduces mortality risk by 25%.

Tip #26: Avoid hearing and vision loss: 1 in 3 people older than 60 has significant hearing loss, but most older adults wait 5 to 15 years before they seek help; Get glasses and hearing aides if you need them.

2019 World Health Organization recommendations: Risk reduction of cognitive decline and dementia

* Exercise: 150 minutes/week

* Mediterranean diet

* Stop Smoking (#1 cause of death globally)

Reduce Alcohol consumption: (1-women; 2-men, per day)

Engage in cognitive training

Be social engaged

Maintain a normal BMI/weight: (BMI under 25)

Treat hypertension, high cholesterol, diabetes, depression

Wear hearing aides

Don't use supplements: (B, E, multi vitamins, etc.)

2019 Rush Study: 60% dementia reduction

Do 4 out of 5 behaviors:

- 1 regular exercise (moderate to vigorous, 150 minutes per week)
- 2 cognitive stimulation 2 or 3 x week (reading the newspaper, visiting the library or playing games such as chess and checkers)
- 3 brain-healthy diet (MIND diet (Mediterranean-DASH diet)) (leafy green vegetables, beans, olive oil, nuts, poultry; less meat, sweets, fried food)
- 4 not smoking
- 5 light to moderate alcohol consumption (1 glass of wine per day)

Ten Commandments for Brain Healthy Lifestyle:

- I. Choose thy parents wisely (For brain genes & IQ)
- II. Exercise daily.
- III. Minimize risk factors for cerebrovascular disease (HTN, Hyperlipidemia, DM, overweight, smoking)
- IV. Eat a Mediterranean Diet
- V. Maintain intellectual engagement throughout life
- VI. Stay socially engaged with others.
- VII. Get sufficiently good quality sleep
- VIII. Drink 1 drink of alcohol per day
- IX. Manage your stress effectively
- X. Don't text or use cell phone while driving.

Remember that most of our ability in older age is based on cruising on what we already know, not on the cognitive skills that tend to decline; And that life satisfaction is far more than cognition. Life is not all about cognitive ability: most elders report being satisfied with their lives.

Lothian Study: Illnesses at age 85: none had none; most had 4-5, some 7-8-9; 78% rated their health as good, very good, or excellent. No correlation between life satisfaction and IQ at age 11.

While it is important to remain vigilant about maintaining good health, it is equally important to acknowledge that there are individual differences during the aging process. You should discuss any concerns you may have with a healthcare professional.

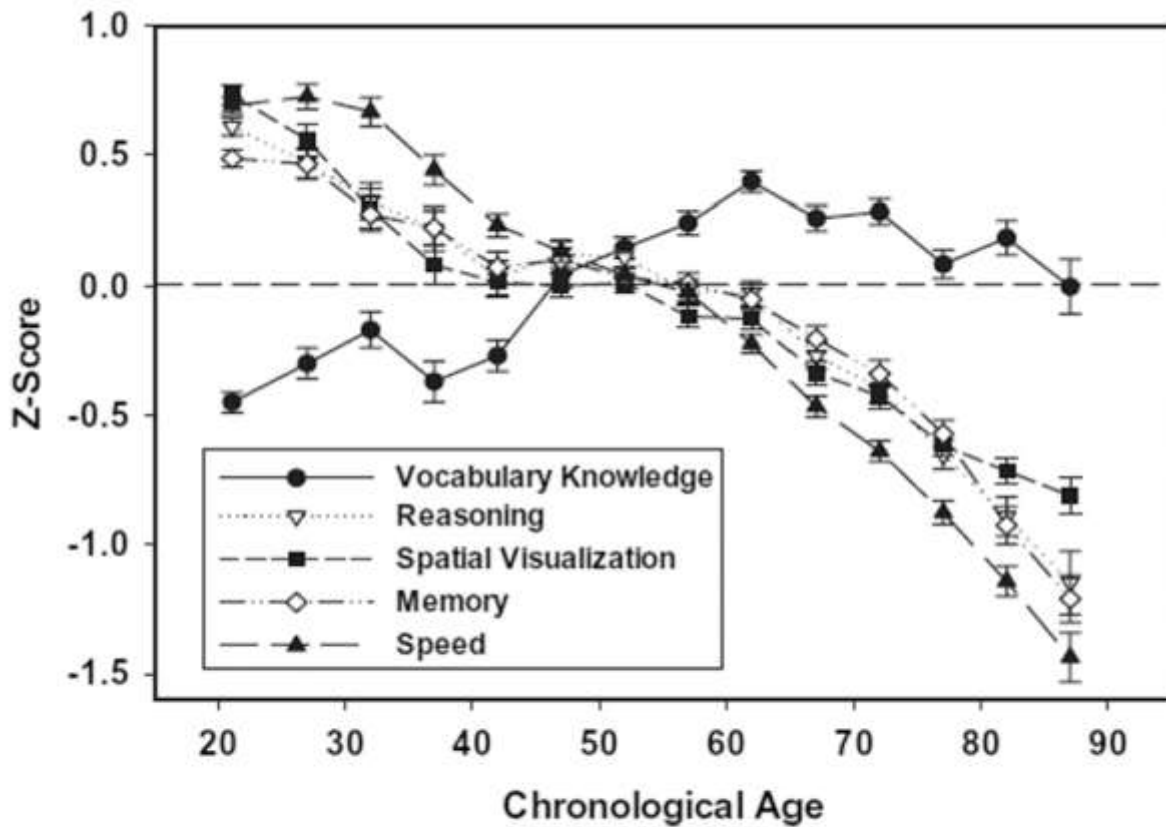


Fig. 1. Means and standard errors for composite scores in five abilities as a function of age based on data from studies by Salthouse and colleagues (e.g., Salthouse, 2009a). Sample sizes ranged from 2369 to 4149.

All of the above is about normal aging. For comparison the following symptoms are known to typify the beginnings of Alzheimer's dementia:

1. Difficulty remembering things that just happened: Forgetting dates or events; repeatedly asking for the same information and relying more and more on family members or reminder notes to handle daily tasks. AD affects new information memory.
2. Inability to plan or solve problems: Struggling to track monthly bills or solve simple math problems. Taking longer to do these things may be another sign.
3. Losing track of dates, seasons and time: If it isn't happening right now, Alzheimer's sufferers may not understand it. Forgetting where they are and how they got there are also common symptoms.
4. Misplacing things: Putting items in unusual places; struggling to retrace steps to look for a lost item and, in some cases, accusing others of stealing.
5. Mood and personality changes: Alzheimer's can produce anxiety, confusion, depression or suspicion. It can make people become upset much more easily, especially when they're away from home.
6. Poor decision-making: Having poor judgment with money or frivolously giving it away. Some people with Alzheimer's may stop grooming habits or keeping themselves clean.
7. Struggling with conversations: Challenges with vocabulary, such as calling things by the wrong name, inability to follow or join a conversation and repeating the same stories.
8. Trouble completing familiar tasks: Trouble driving to a familiar place, forgetting how to cook a simple meal or remembering the rules of a favorite game.
9. Vision problems: Having difficulty identifying colors or contrasts, judging distance or reading. Poor driving may result.
10. Withdrawal from social or work activities: Failing to complete work assignments, giving up hobbies or avoiding social situations.

These are all different from the normal cognitive deficits found in people with normal intellectual abilities

- www.alz.org
 - Web site is a rich resource of evidence-based content related to Alzheimer's and Dementia

Biography:

Major Issues in Cognitive Aging, Timothy a. Salthouse, 2010

Selective review of cognitive aging, Timothy A. Salthouse, J Int Neuropsychol Soc, 2010

Normal Cognitive Aging, Caroline N. Harada, Marissa C. Natelson Love, and Kristen Triebel, Clin Geriatr Med, 2014

Translational research on reserve against neurodegenerative disease: consensus report of the International Conference on Cognitive Reserve in the Dementias and the Alzheimer's Association Reserve, Resilience and Protective Factors Professional Interest Area working groups, Robert Pernecky et al., 2019

Join:

<http://www.brainhealthregistry.org>

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