

1 AGING IS NOT INEVITABLE, IT IS AN OPPORTUNITY

Our greatest freedom is the freedom to choose our attitude.

Viktor Frankl, Austrian psychiatrist,
author of *Man's Search for Meaning*

A 94-year-old businessman came to see me for an annual check-up. He had been consulting me on a yearly basis for three years and each time had the same complaint. "I am developing Alzheimer's disease," he said. I asked why he thought that he had the disease. His response? "I can't remember who wrote *The Red and the Black*,"¹ he said.

I evaluated him a third time using standard blood tests, and assessment of cognitive functions (tests of memory and reasoning). A year earlier, magnetic resonance imaging of the brain showed some shrinkage of the brain, often seen in healthy people of his age. Memory and cognitive testing showed no decline from the previous year and revealed no significant shortfalls. He also complained of pain in his knees. "When do your knees hurt?" I asked. "When I walk up the four flights to my office," he replied.

At this point I told him that failure to remember the author of *The Red and the Black* was not a sign of Alzheimer's disease. Although I applauded his desire to exercise, I suggested he use the elevator rather than walk up four flights of stairs. I noticed his visits of the previous two years were quite similar to this one, and each time he was concerned about his memory and physical functions. I counseled him

¹ A historical novel of Stendhal, 1830, a French novelist.

as to the effects of age on the brain and the body. I told him that of all the men born 94 years ago in the United States, only 8 percent were still alive, and less than half of those alive still lived independently, and very few of them would have an office and be able to walk up four flights of stairs. It's important for a person to understand the relative nature of his or her position in life.

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I encouraged him to consider his loss of abilities in the context of his extraordinary survival and overall maintenance of cognitive and physical skills. I told him not to expect his memory to work as well at 94 as it did at 49!

Our response to a situation is heavily affected by our expectations. If the thoughts in anticipation of an event are negative, our perceptions will be biased negatively. If, on the other hand, we have positive expectations, we may be biased in the other direction. Thus, it is critical to consider what our expectations of aging are.

In this chapter we will first consider our expectations and goals for aging and learn what it is that happens as we get older. We will also review the important role of the immune system with aging and how an evolutionary approach helps to inform our choices of actions to improve our aging.

What Are Our Goals for Aging?

As we consider the scenario presented by aging it is important to ask what our expectation are. Do we wish to have normal aging, where the decline in function of all organ systems is accompanied by an increased risk of dying (mortality) and increased risk of disease? Consider what happens with normal aging. Most Americans over the age of 65 years suffer from high blood pressure. And

most say they don't have excellent or very good health. On average, people over the age of 65 years have more than two chronic medical conditions. According to the United States Social Security Administration (www.ssa.gov/OACT/TR/2021/index.html), more than 40 percent of people over the age of 75 years have difficulty in physical functioning and 50 percent of people aged 85 years and over need personal assistance with everyday activities. Changes with aging are summarized in Table 1.

The goal isn't "normal aging." The goal is to make terrific choices so you can achieve *exceptional* aging.

I propose three goals for aging (Table 2). The first two are rather obvious, but the third goal is not properly recognized. The first goal of aging is not dying. This is not to deny the inevitability of death, but rather to state the clear truth that most people want to continue living. Most of us want the opportunity to survive from one day to the next. Similarly, we all share the second goal of aging, which is to avoid disease. It's perfectly reasonable that a 30-year-old woman will hope that she can live to be 70 years of age (and more, of course) and, at that older age, she will not have cancer, coronary artery disease, Alzheimer's disease, or other age-related conditions.

Table 1 *Changes with aging in the body and brain*

Decreased

- Recall, reasoning, spatial awareness, speed of perception, and numerical abilities
- Learning and processing speed
- Spatial and working memory
- Size of the brain and density of synapses
- Production of neurotransmitters (especially acetylcholine) involved in memory and learning
- Myelin in the white matter of the brain

Table 1 (cont.)

- Speed of impulse transmission in peripheral nerves
- Cerebral blood flow and use of oxygen and glucose
- Serotonin and dopamine receptors
- Visual acuity, depth perception, contrast sensitivity, and dark adaptation
- Vestibular function (balance mechanisms in the ear are less effective)
- Hair cells in the inner ear, cochlear neurons, and high-frequency hearing
- Discrimination of source of sounds and of target from noise
- Vibration sense in feet
- Exercise tolerance
- Pacemaker cells in the heart (more atrial fibrillation)
- Heart relaxation, maximum heart rate
- Sensitivity for blood pressure changes, with increased potential for low blood pressure with posture changes, blood loss or dehydration, fever, sepsis, or medications
- Elastic quality of the lung
- Strength of respiratory muscles and respiratory capacity
- Sex hormones
- Insulin responsiveness
- Regulation of the stress response with delayed recovery
- Ability of the kidney to filter blood and dilute and concentrate the urine (increased risk for dehydration)
- Thirst perception
- Water regulatory capacity
- Total body water
- Muscle mass and strength
- Bone strength
- Maximal oxygen consumption
- Exercise tolerance

Table 1 (cont.)

- Gut absorption, contraction, blood flow, and digestive enzyme secretion
- Microbial diversity in the gut

Increased

- Variability of all measures of structure and function
- Toxic misfolded protein collections in the brain
- Inflammation in the blood and brain (“inflammaging”)²
- Body fat
- Reaction times
- Vocabulary, semantic knowledge (crystalized intelligence, accumulation of knowledge)
- Risk for dehydration and high or low blood sodium levels
- Blood vessel stiffness and risk of hypertension
- Likelihood of falls
- Risk of many diseases of the brain, lungs, heart, blood, gastrointestinal tract, circulation, skin, and other organs

Table 2 *The three goals of aging*

1. Not dying (survival)
2. Not being ill (not having disease)
3. Being fit (enhancing and maintaining function, having strong cognitive, physical, psychological, and social reserves)

Let’s add another dimension to these goals to allow ourselves to age exceptionally.

The third goal for aging must be the maintenance of high levels of function (fitness) into later ages, as well as continued well-being and resistance to loss of function.

The third goal for aging must be the maintenance of high levels of function (fitness) into later ages, as well as continued well-being and resistance to loss of function. Imagine two 70-year-old people who have both met the first two goals of aging (that is, they have survived to the age of 70 and have not developed disease conditions of note). However, one may not be able to walk more than a short distance without hip pain and shortness of breath, is no longer able to play golf or swim, has diminished exercise tolerance, and has a lowered resistance to the damaging effects of stress. The other 70-year-old is physically fit and happily participating in meaningful activities, with good abilities to resist stressors. We are all confronted with physical and psychological challenges as we get older. The ability to survive and prosper despite these challenges is a critical factor in aging.

Persons concerned about quality of life with aging must consider all three goals. How can they achieve the three goals of an active, healthy, and long life? That is, what can they do enhance their chance of a long life, free of disease? Equally importantly, they need to ask what they can do to increase the likelihood that they will have the highest level of fitness and resilience (resistance to loss of function) as they age. Resistance to loss of function can also be called reserve capacity. This book presents the theory of multiple reserves (Chapter 2), which examines the concept of the four reserve factors: cognitive, physical, psychological, and social, all of which are key to successfully meeting the three goals of aging.

Avoiding death and sickness is desirable, but it is not enough.

Avoiding death and sickness is desirable, but it is not enough. Just ask the Struldbruggs. In Jonathan Swift's 1726 satirical novel *Gulliver's Travels*, the protagonist visited the

nation of Luggnagg, somewhere near Japan. Occasionally, a baby would be born with a red dot above their left eyebrow. These babies were called Struldbruggs. The red dot was a sign that they would never die. At first, Gulliver thought that this long life would be a monumental gift leading to great wisdom and wealth, but later he realized that these poor creatures aged normally, acquiring progressive tragic disability along the way, without the gift of death to end their suffering. Swift was powerfully illustrating the reality that survival alone is not a proper goal for aging, a truth he would come to know before dying with dementia at the age of 78.^{11,3}

The term “homeostasis” refers to all of the processes responsible for managing and adjusting the activities of the body to maintain stability and resistance to challenges. It is necessary to consider homeostasis beyond the concept of disease avoidance, as there is more to health than the absence of disease. This is illustrated by the word “salutogenesis,” which describes the promotion and maintenance of health.⁴ This is in contrast to pathogenesis, which is the promotion and maintenance of disease. Salutogenesis illuminates the vital concept that health is not a passive process and that we can make a difference in taking control of factors that determine our health and fitness. Likewise, the concept of considering “healthspan” as opposed to “lifespan” demonstrates that the goal should be obtaining years of active meaningful survival, not just survival itself.⁵

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¹¹ A discussion of Swift’s memory disorder is presented in reference 3.

Because the body systems that have reduced function with age are all dependent on each other, declines in function can have magnified effects throughout the body. Interactions between our body systems not only affect our susceptibility to disease, but also our functional capacity with aging. Recognition of this interdependence is a critical factor for successful aging and is the focus of this book.

Aging Is Not Inevitable

As we will see later, the ability of older people to survive illness and maintain fitness is determined not only by the illness itself, but also upon the reserve factors of the person to adapt (as discussed in Chapter 2). It is our reserve factors which maintain the balance of body functions, even in the presence of challenges, such as disease and other sources of stress. Our reserve capacity is another way to present the concept of resistance to loss of function. The maintenance of health and fitness is an active process, which is dependent in large part upon our activities, attention, and attitude.

The importance of our attitude in regard to aging – and where that attitude is often misdirected – is illustrated by the popular phrase “aging is inevitable.” It isn’t. Yet the myth is widespread. A recent review of aging and the cardiovascular system (2020) noted that “Aging is an inevitable part of life.”⁶ I disagree, as many people do not live long enough to get to be old. Aging is not inevitable, because it doesn’t happen to everyone.

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What would Princess Diana, John F. Kennedy, or Martin Luther King Jr. think about the idea that aging is inevitable,

as Diana died at the age of 36, John F. Kennedy at 47, and Martin Luther King Jr. at the age of 39? We all know people who did not live long enough to be old, so we must conclude that aging is not inevitable. On the other hand, aging is an opportunity. To put it another way, everyone is certainly one day older today than they were yesterday, but not everyone will be one day older tomorrow than they are today because our survival from one day to the next is not guaranteed.

One reason that aging is not inevitable is that many people do not reach the ages at which they are considered to be “old” (usually 65 years of age in Western cultures). Of all persons born 65 years ago in the United States, only 86 percent are still living. In the same vein, a 65-year-old person should not assume that they will live to be 80 because of the idea that aging is inevitable. At the time of writing, according to the United States Social Security Administration, a healthy 65-year-old man has a 62 percent probability and a healthy 65-year-old woman a 71 percent probability of living to be 80 years old (see www.ssa.gov/OACT/TR/2021/index.html).

Second, and most importantly, aging is not inevitable because the declines of function seen with aging can often be avoided. Yes, that’s the reality of aging.

For example, a 60-year-old woman with coronary artery disease could improve her cardiac function with exercise, statins, improved diet, reduced alcohol intake, and quitting smoking, so that by the age of 70 her cardiac function would be better than it was at the age of 60. This does not imply that all age-related changes can be prevented, but many of the declines in function we see with aging are not produced by aging alone but are the result of harmful lifestyle behaviors that can be changed with significant effect.

What can be done to enhance the opportunity of aging?

Since many people do not get a chance to be old we should not consider our survival to be inevitable. We should reflect on what can be done to enhance the opportunity of aging. To this end, we should all be asking ourselves two central questions:

How can we influence the quality and length of our lives through lifestyle measures, in consideration of the interdependent forces we have been discussing?

How can we maximize the meaning of our lives to make the most of the opportunity presented by aging?⁷

Many people, including some medical professionals, have a shockingly negative view of aging. Consider a 2020 report published in *Lancet* entitled “Ageing without dementia: can stimulating psychosocial and lifestyle experiences make a difference?”⁸ Written by leaders in the field of gerontology, its authors argue that “ageing is the accumulation of biological deficits resulting from genetically and environmentally induced alterations that undermine the homeostatic balance of the organism, progressively leading to physical and cognitive impairment.”⁸

Let’s take a moment to unpack this. In aging, there are deficits in bodily functions related to genes and environment. These declines interfere with the ability of the body to maintain health and fitness. So far, so good. The problem is in the last phrase when the authors suggest “physical and cognitive impairment” is inevitable. *It is not.*

As you will see in the following chapters, many older people do not suffer cognitive losses, and people, as they age, may build muscle mass and improve abilities as they get older through physical exercise. A remarkable feature of aging is that even in later stages of life there are recovery mechanisms which help to retain function in the face of structural decline.

Although it is true that there are declines with aging, they do not always cause physical and cognitive impairment.

For example, a 50-year-old runner may be able to increase their performance over the 10 years until the age of 60 through improved training. Although it is best for people to learn to play a musical instrument in childhood, it can be done in adulthood. An enthusiast who starts violin lessons at the age of 50 will not be playing with the New York Philharmonic. But she can, through teaching and practice, obtain sufficient skill to develop the potential for decades of joy from music making. Many older people work hard throughout their life and find that their later ages are the most joyful of all.

In order to consider what can be done to improve our aging we must first consider how we are affected by aging.

What Is Happening with Aging?

Now that we understand the three goals, and the concept that aging is not inevitable, we must consider the reality of human aging. What is happening?

Aging is accompanied by the reduced function of every system of the body (see Figure 1 and Table 1). What's important to know is that this reduced function is not a disease, it's highly variable from person to person, and does not necessarily lead to impairment in activities. Although every organ has reduced function with aging, this decline is accompanied by increased variability.¹⁰ This means, as shown in Figure 2, that walking speed typically declines with age. But that's not true for everyone. While most young people walk at similar rates, some older people walk as fast as younger people, while others slow dramatically. Many older persons will maintain function in later life. This is not the case only for walking speed, as the variability of every measure of body structure and function is greater for older than for younger persons. This is powerful evidence that aging declines do not happen to everyone and that it matters what we do about the opportunity for aging.

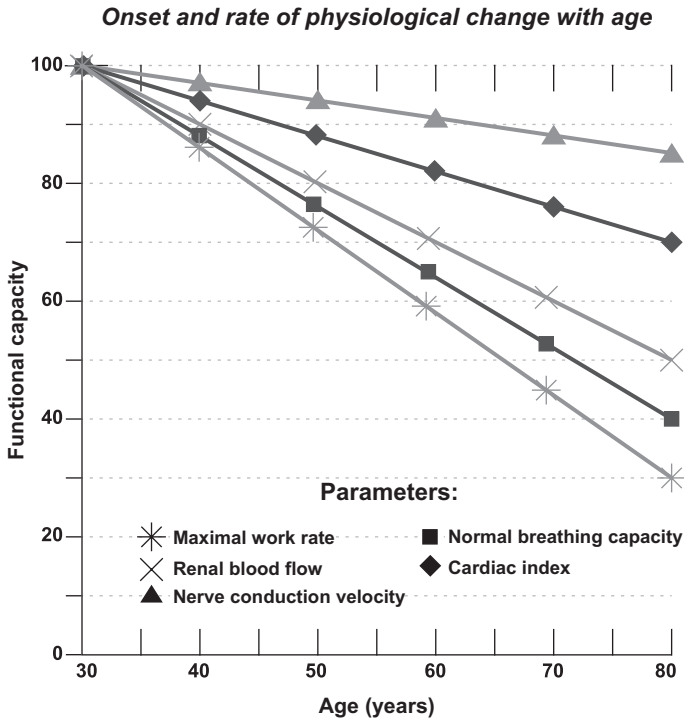


Figure 1 Declines in function with aging

All bodily functions decline with age. This includes maximal work rate, blood flow in the kidney, maximum breathing capacity, nerve conduction velocity, and cardiac output, as well as many other functions. The lines indicate the relative declines in function from ages 20–30 to 80–85. These changes do not represent a disease and do not occur to the same degree in every person. (Adapted with permission from reference 9.)

An important thing to realize about reduced function in aging is that in many cases normal function can be maintained through healthy lifestyle choices. For example, 30–50 percent of centenarians (aged 100 years or older) are cognitively intact. Muscle mass declines with age, but some people have excellent muscle mass even

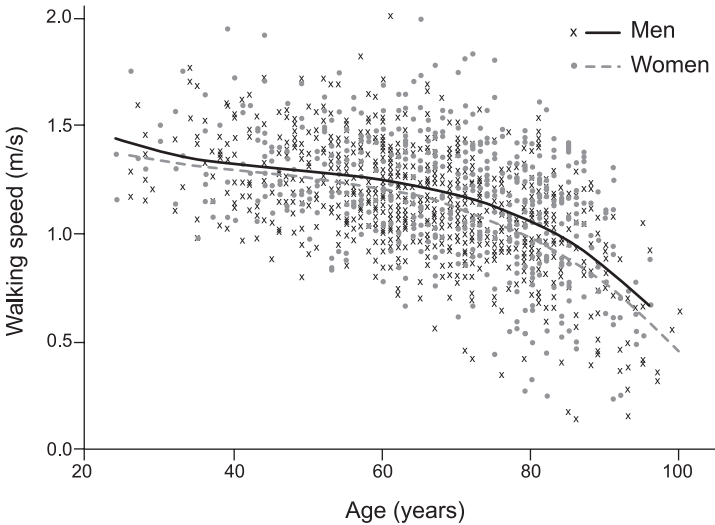


Figure 2 Variability increases with age

Usual walking speed declines with age, particularly after the age of 65. However, there are many people over 65 years old who have a normal walking speed. The data for the younger ages are more closely aligned to the average, while older persons have considerably more variation in their walking speed. This increase in variability with aging is true for every aspect of function. (Adapted with permission from reference 11.)

after 65 years, and it's possible for most people to build muscle mass through exercise, no matter the age. Some of the declines with aging noted in studies of older people are not caused by aging alone, but by the early stages of disease that may be present in a premature state which is difficult to detect (such as Alzheimer's disease).¹²

This is what happens in the brain with aging: There is a reduction in brain volume, which is more marked in areas involved in learning and memory. The structure of the myelin sheath, which isolates axons connecting neurons, also declines. This activates the immune system in the brain, which needs to repair the damage. Abnormal

collections of proteins develop in the brain along with impaired removal of toxic molecules, and loss of synapses (gaps between nerve cells responsible for communication). There is also improper folding of brain proteins with aging. (This is a critical concept in aging and is discussed in Chapter 5.) Inflammation in the brain produces molecules which impair learning. All of these age-related changes in the brain can lead to a loss of function as we grow older. Cognitive activities at work and at home can help delay these changes and enhance our cognitive reserve; such activities are closely related to psychological factors and social interactions. Furthermore, it has been discovered recently that important immune cells in the brain which are involved in learning and memory are strongly influenced by gut bacteria (our microbiota). And these organisms are controlled by what we feed them (our diet!). So, our microbiota are a key component of our physical reserve.

We need to consider what happens to our immune system with aging, because it is central to the preservation of function as we get older. Also, we are able to influence the nature of our immune system through our actions, as we shall soon see.

The Immune System in Aging

The immune system is an intricate network of cells and molecules, which protects us from infections and assists in the maintenance of structure. It plays a vital role in aging in the body as well as in the brain. Inflammation is a protective mechanism which allows us to fight infection and defends us from disease-causing agents. *Innate immunity* refers to the system providing initial rapid defenses, independent of previous exposures, with no memory (repeat exposures are treated the same) and lasting only a few days (such as the body's initial response to a cold).

Adaptive immunity is slower to develop, involves immune cells, and lasts a lifetime (such as vaccinations). There may be activation of the innate immune system with aging, which is found in many neurological and systemic disorders and has been called “inflammaging.”² Difficulties can develop when inflammation is ineffective and pathogens enter, replicate, and damage tissues. However, it is also a problem when inflammation is excessive. Immune mechanisms can be active (pro-inflammatory) or regulatory (anti-inflammatory).

With aging, there are often excessive pro-inflammatory factors and inadequate regulatory mechanisms. This low-grade process of inflammaging is linked to several diseases of aging, such as cardiovascular disease, stroke, diabetes, Alzheimer’s disease, Parkinson’s disease, and cancer.² Chronic low-grade inflammation can cause cellular damage in localized areas of the body and also influence cellular process at remote sites. In addition, the production of growth factors in the brain may be impaired by inflammation, and inflammatory molecules may damage neurons, increase the production of misfolded proteins involved in many age-related brain diseases, and increase the assembly of free radicals. Free radicals are highly reactive molecules with unpaired electrons produced by metabolism, which damage other things, such as carbohydrates, DNA, and proteins and impair cellular structures, such as the mitochondria, which is the source of the cell’s energy.

The inflammation in the brain is linked to the inflammation in the body. The wonderful part of this is that the bacteria in the gut strongly influence these processes, both in the brain and the body. Excessive inflammation in the body and brain can be caused by a diet which enhances the growth of gut bacteria that enhance inflammation. And inflammation can be reduced with the presence of health-enhancing bacteria, also related to diet.

This means that our diet can contribute to an unhealthy pro-inflammatory state or a health-enhancing regulatory, anti-inflammatory state.

The brain is protected from the circulation by the blood–brain barrier, which tightly regulates the entry and exit of molecules and cells from the blood to the brain and vice versa. Despite the actions of the barrier the brain hosts an important population of immune cells that have been present from birth and also cells that regularly cross the barrier and monitor the health of the brain. Recent research has shown that these cells are needed for learning and memory as well as protection from pathogens.

As neurons age they release factors that increase inflammation in the brain, which through the activity of immune cells and related molecules can be damaging. It is a delicate balance of function that controls these processes, which are influenced by genetic and environmental factors, including diet and the microbiota (all the microbes that reside inside our body and on our surfaces). If the inflammatory process becomes excessive it can lead to neurodegeneration.¹³ Inflammation can also affect the brain directly, such as with meningitis, encephalitis, or brain abscess. Dormant microbes in the brain that are not replicating can also influence inflammation without active infection. The DNA of microbes can become implanted in human DNA sequences and influence metabolism, even without replication of the microbe. Inflammation elsewhere in the body can also affect the brain through the passage into the brain of inflammatory cells and molecules.

The balance of inflammation in the brain can often become poorly regulated with aging. This can result from poor clearance of toxic molecules from the brain, increased production of inflammatory molecules, abnormally folded proteins, fewer neuroprotective factors (growth factors), and changes in the gut microbes. These factors can act

in a dangerous feed-forward loop in which inflammation leads to more protein misfolding, leading to more inflammation. These processes which impact inflammation and protein folding are linked to our activities through life, including toxic exposures (such as smoking, alcohol, toxins, and chemicals), poor diet, head injury, and a lack of physical and mental activity. This means that it is possible to reduce our risk of poorly regulated inflammation as we get older by making proper lifestyle choices. Although the ability of the brain to deal with improperly folded proteins decreases with age it is possible to enhance our capacity to manage errors in protein folding. Dietary factors as well as mental and physical activities (presented in Chapter 20) can help manage the processes of inflammation.

The management of changes in inflammation with aging are important for the maintenance of function and avoidance of disease in everyone. Why are these issues especially important for older persons?

Old Persons Are Not Well Protected by Evolution

Evolution has not prepared us for a long life. Human evolution is critical to understanding human aging, so let's briefly explore it. It is estimated that our species, *Homo sapiens*, is one of the youngest of all life forms on Earth. We may only be about 100,000 years old as a species. At first glance, that number may seem high, but in comparison, chimpanzees – our closest relatives – are five to seven *million* years old. So, chimps have been here about 60 times longer than us. For almost all of human history, we have been living as hunter-gatherers with a profoundly different lifestyle than the one that we have today. Hunter-gatherers are nomadic people who live by harvesting wild food through hunting and fishing. The genes we have inherited were chosen by natural selection because they aided the survival of our

ancestors, who were living in a different world than the one we are living in today. To be blunt, our genes do not prepare us for modern life, or, as you will see, old age.

For most of human history (perhaps prehistory would be more accurate), there were few people who grew old, because of infectious diseases, injuries, and scarce resources. Only a small percentage of the population lived to be over 65 years of age. From 1990 to 2020, the percentage of Americans aged 65 years and older has gone from about 4 percent of the population to nearly 20 percent of the population. Currently, about 9 percent of the world's population is 65 years of age or older. For most of human history, the percentage of the population who lived to be 65 years of age or older was just 3 percent. Studies of the teeth of ancient communities show that few persons lived long lives. In fact, life expectancy for most of human history was about 25 years. This is all to say that our genetic inheritance does not prepare us well for old age.

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In short, evolution doesn't care about our survival to old age. What is essential to evolution is the dissemination of genes to the next generation. As far as evolution is concerned, it is imperative that we live long enough to have and raise children so our genes can be passed on. Survival into old age does not influence the passage of our genes.

This is not an ethical or a moral issue, it is just the way evolution works through natural selection. Thus, genes which decrease the chance of living to be 20 years of age will be diminished in the population by negative selection, because people with the genes linked to early death will raise fewer children. On the other hand, genes which make it likely that one will not live to be 70 years old after they have survived to 40 years will not be subject to such

negative selection because few people have children over the age of 40 years. To put it in another way, genes which enhance survival to 70 years of age after reaching 40 years will not be selected for, because they will not enhance the occurrence and survival of offspring. Of course, genes that enhance survival in early life may very well continue to enhance survival in later years. But genes with a small positive effect in early life, but a negative effect in later life, will be favored by evolution, because there are so many more children than older persons.

Scientists have debated whether grandparents aid the survival of their grandchildren because of their wisdom and knowledge of the world.¹⁴ Grandmothers, in particular, are thought to have enhanced transmission of cultural knowledge and complex social connections. While this is certainly true, it must be balanced by the fact that, until recently, older and possibly disabled older persons compete for scarce resources, which may decrease the survival of their offspring.

Let's consider aging in the context of the past 100,000 years of human history, since that is the time when our genes were selected. Our ancestors did not have access to plumbing, electricity, books, grocery stores, hospitals, doctors, or cell phones (and agriculture is only about 10,000 years old). As we touched on above, our genes were selected because they were adaptive to us in the environment in which we were living around 100,000 years ago, not because they are adaptive in our current environment. For example, the most important nutritional problem our distant ancestors experienced was not having enough to eat. The foods available to our ancestors were not as high in calories as foods that are readily available today – they ate more vegetables, less meat, and no processed foods. In contrast, the most important nutritional problem today in middle- and high-income countries is having too much to eat. We have not had this situation of nutritional excess

long enough to develop effective genetic mechanisms to protect ourselves from overeating. Similarly, our ancestors were physically active out of necessity. If not, they would have had little to eat or drink and, perhaps, die. Even today, many people around the world need to travel every day to get water.

So evolution favors youth. The situation is different for older people – we are not really made to live that much longer than 40 or 50 years. People over 50 years of age are not as well protected from disease and loss of function. This doesn't mean that aging itself is a disease, just that the balance of health is more delicate with advancing age. One way to consider this is to imagine a group of 70-year-old men playing American-style football. There would be a stretcher on the field after every play and a long line-up of ambulances would be required.

The bottom line here is that survival to late years of age has been a relatively uncommon event in the 100,000 years of human history. Very few people got to be old until the twentieth century. Older persons are not as well prepared to face the stresses of the world because of the evolutionary factors discussed above. *As a result, it is necessary for older persons to consider the effects of their lifestyle choices on their four reserve factors and their ability to age successfully.* Awareness of these factors is important for our appreciation of the impact which our activities have on our aging.

Our ancestors were more physically active than many people are today. Were they also more mentally active? Years ago, I was backpacking with my son in a side ravine of the Grand Canyon in Utah. Even though we had a guide, we got lost and found ourselves deep in a canyon, and two miles away from our campsite when the sun set. It was dark and we had no flashlights (and cell phones with lights were 20 years away). After an hour of uncomfortable scrambling, we were relieved to see a full moon appear directly above us, lighting the path back to the campsite

and helping us avoid stepping on rattlesnakes. As we walked, a thought occurred to me. Would the moon travel on a path parallel to the canyon, allowing for a few hours of moonlight, or would the moon travel on a path perpendicular to the canyon, in which case its light would soon be gone? I realized that this was the first time in my life that I had considered the path the moon was taking in the sky. In contrast, 20,000 years ago, our ancestor's awareness of the cycles of the moon were vitally important for their survival.

It is likely our ancestors were more mentally active than many people are today. To live in intimate daily contact with the natural world one needs to be continuously aware of the environment. In the absence of farming, refrigerators, and grocery stores, our ancestors needed to know where to find food, how to stalk, kill, and butcher animals, what was safe to eat and what was poisonous, and what time of year it could be found. Equally important was the danger of threats from neighbors, predators, insects, weather, and other hazards. People needed to be aware of the world for their own protection. Such a high level of awareness of the natural world is not required for survival today. For example, consider my highly reliable way to determine if a mushroom is safe to eat. I know one bite of certain mushrooms can fatally damage my liver. My method for mushroom safety evaluation is that I will not eat it if it is not wrapped in plastic, and not sold in a store. Learning mushroom identification was important for my ancestors but it's not one of my necessary skills.

These evolutionary considerations should frame our attention to the four reserve factors (cognitive, physical, psychological, and social). Because we are not "designed" by evolution for a long life, we must be prepared to use all the resources at our disposal to resist the challenges that we face as we get older. These reserve factors are needed to deal effectively with the many kinds of physical and

mental stress that we all encounter. Resilience requires abundant resources in the brain, the body, and social ties as well as healthy ways of responding to life events.

Conclusion

The need for us to take an active role in our own aging is illustrated by an 1884 quote about the advance of democracy from the American poet James R. Lowell. “There is no good in arguing with the inevitable. The only argument available with an east wind is to put on your overcoat.” Because aging is felt to be inevitable, people believe its manifestations cannot be altered. Understanding that aging is not inevitable allows us to prepare ourselves for a critical period in life’s journey. Not only can we wear the metaphorical overcoat to protect ourselves from the forces of aging, we can also do things to affect the magnitude and characteristics of our own aging process.

I toyed with the idea of calling this book *Arguments with Aging*, to represent the need to be actively involved in the process of aging, and not passive observers. Staying healthy and active with a life full of meaning as we age requires fierce, tenacious attention to the factors that not only protect us from the winds of aging, but also change its forces and manifestations.