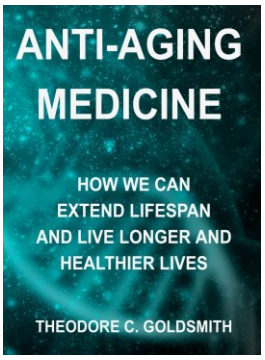

Anti-Aging Medicine: How we can extend lifespan and live longer and healthier lives Book Summary

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Would you like to live a longer, healthier, and happier life?

For centuries it was widely thought that aging was an unavoidable and untreatable aspect of life. We can find treatments for highly age-related diseases such as cancer and heart disease but aging and "death of old age" was inevitable, a law of nature. Many people still think of human aging as the sort of inescapable gradual deterioration we see in automobiles, bridges, and other inanimate objects.

However, today there is extensive evidence and new theoretical support for the idea that aging is itself a treatable condition and can be generally delayed by anti-aging agents as well as lifestyle choices such as diet and exercise. Substantially funded research is now underway to find and develop those agents and protocols.

The reader may be surprised to read that going into the 21st Century there was no wide scientific agreement regarding even the general nature of aging despite decades of spectacular progress in medicine. After all, highly age-related diseases were *the* major cause of death and health care expense in developed countries and we can't really understand these diseases without understanding aging. Surely by the year 2000 we would have definitively determined how and why we age!

Today there is still major scientific disagreement regarding even the fundamental nature of aging and the reasons for this will be discussed in detail. Dramatic and some rather recent advances in genetics science have significantly altered modern evolution theories and dependent aging theories.

This book deals with two different questions:

First: Why do we age? This is the single most important unresolved scientific question of our time and the answer could substantially affect the lives of billions of people! Dependent questions

include: Is aging itself treatable or untreatable? Is generally extending human lifespan possible or impossible? There are many theories of biological aging and they point in very different directions regarding these issues.

Second: What can we personally do in order to live longer, healthier, more productive, and happier lives? Are there medications, diets, and exercise regimens that help with this effort? How should we proceed with an anti-aging regimen? How does an anti-aging effort relate to our existing health care?

Before we proceed, we should review some terminology:

Lifetime refers to the time any particular human or other organism lives.

Lifespan refers to the internally determined time a member of a particular species would typically live in the absence of external limitations such as infectious diseases, injuries, predators, food supply, habitat, or harsh environmental conditions, e.g., zoo conditions.

An *age-related disease* is one in which incidence drastically increases with age. For example, cancer is more than 1000 times as likely to kill you at age 70 as at age 20. Heart disease, and stroke are also highly age-related and Alzheimer's disease is essentially unknown in young people.

Age-related conditions are more universal in older people and include hair and skin changes, loss of muscle mass and strength, and general sensory deterioration including balance.

Anti-aging medicine has multiple interpretations. *Cosmetic medicine* can include delaying the visual *appearance* of aging with treatments such as Botox, wrinkle crème, and face lifts, and will not be further discussed here.

Healthy aging (sometimes described as *better aging* or *aging gracefully*) refers to extending the active and productive portion of a lifetime without necessarily increasing total lifetime. Most people would like to reduce the length of the nursing-home-stage in favor of a longer productive and more enjoyable life.

Finally, *lifespan extension* refers to generally delaying aging, increasing both the healthy and total lifetime and therefore essentially includes healthy aging. Aging is itself a *treatable* condition. Aging is functionally like a disease as opposed to an unalterable aspect of life.

This book describes the history and main controversies regarding the nature of and especially the "treatability" of aging and concentrates on current theories, medical research developments, and developments in the practice of anti-aging medicine.

For most of human history, aging was much less important to human health and well-being because most people died at relatively young ages from infant mortality, injuries, and infectious diseases. Today dramatic improvements in medicine, health care, and general safety have resulted in a situation where most people in developed countries die of aging or diseases mainly or even exclusively caused by aging.

Aging Theory Overview

Theories of biological aging (senescence) are important to medical research on aging and age-related diseases and conditions because aging and associated symptoms are difficult subjects for research and theories can help guide research directions. Of course, an incorrect theory might substantially hinder research!

Among those who study aging (*gerontologists*) there is now fairly wide agreement that aging is a *trait* or inherited organism design characteristic that has been determined in some way by the evolution process. Therefore, evolution theory and specifically the relationship between the evolution process and the aging trait are critical to medical research on aging and related symptoms. Modern *evolutionary* aging theories are based on slightly different minor modifications to Darwin's survival-of-the-fittest concept. Unresolved scientific arguments regarding the mechanics of evolution and the evolutionary nature of aging have existed at some level since Darwin's theory was introduced (1859) and continue today.

A key aspect of evolution theory is that it applies to all living organisms and was derived from Darwin's comparative observations of many different animal and plant species.

Although there is still major *religious* opposition there is now wide *scientific* agreement on most aspects of evolution: All species are substantially related to each other. Humans are mammals and are even more closely related to other mammals. Current species are descended from earlier, different, species, that were descended from still earlier species, that were originally descended from a single-cell species billions of years ago. Every day somebody somewhere makes discoveries (especially in genetics) that confirm these aspects.

There is also wide agreement with Darwin's ideas that the evolution process is capable of distinguishing between tiny differences in an organism's ability to survive and reproduce and that current complex organisms are the accumulative result of billions of years of tiny advances.

Current disagreements about evolution concern obscure details of the evolution process that only affect a few observations and are therefore frequently not even mentioned in introductory biology courses. However, these unresolved details are essential to and essentially determine dependent aging theories. Scientific disagreements about the nature of aging are actually disagreements about the nature of evolution!

Most of what we know about evolution comes from studying differences between different species. Therefore, evolutionary aging theories need to provide multi-species explanations for observations about aging. (Some theories only attempt to explain human aging and some mammal aging theories essentially ignore non-mammal evidence.)

There are ***three*** concepts regarding the relationship between aging and the evolution process

One, Darwin's evolution theory as taught by Darwin in 1859 and currently widely taught says that evolution causes organisms to acquire inheritable design characteristics or traits that cause *individuals* possessing them to produce more adult descendants. This idea fits with about 99 percent of the design characteristics we observe in different organism species and explains why

we have eyes, ears, fingers, and toes because all of these traits plausibly help individuals survive and reproduce. This survival of the fittest or natural selection idea was the only widely held evolutionary mechanics theory (or theory about how the evolution process works) until about 1950. According to this concept *the force of evolution is toward evolving internal immortality or the absence of any internal limitation on lifetime* because that would maximize an individual's opportunity to reproduce.

Of course, it was obvious even in 1859 that aging *did not* help but rather *hindered* the ability of humans, other mammals, and most more complex animals to survive and reproduce. If the evolution process has been working toward making animals live longer and longer for billions of years, why aren't we and other animals internally immortal? Some of Darwin's contemporaries asked this question!

Concept one therefore logically leads to the idea that aging is the result of fundamental limitations such as laws of physics or chemistry that cannot be overcome by the evolution process, which in turn leads to the idea that lifespan extension is physically or chemically impossible, still a commonly held idea among strict Darwinists! "Impossible" tends to trump any amount of direct evidence. There are literally books full of laws of physics and chemistry to pick from. If we only consider human aging, this is a reasonably plausible explanation and many versions of this idea have been proposed.

However, many observations, especially regarding aging in other mammals and other non-human species, conflicted with this idea (Chapter 2) eventually leading to concepts two and three. Aging was one of the very few biological observations that did not fit with Darwin's ideas. Even Darwin conceded that aging was an unresolved evolution issue.

Two, around 1950 a *modification* to Darwin's natural selection idea suggested that *populations* of various species were not significantly affected by aging. In effect, nature did not care how long individuals lived as long as they lived long enough to produce some descendants. The force of evolution is toward achieving a particular, *minimum*, species and population-specific lifespan that meets this requirement. Living longer than the minimum did not produce a disadvantage but also no advantage. Other factors that influenced the lifespan needed by a particular population of a particular species included the degree of predation and other external factors such as famines and droughts that would affect external causes of death. This idea provided a much better fit to observations about aging, especially the observation that chemically and physically similar species (that would presumably be similarly affected by chemical and physical limitations) often had drastically different lifespans.

Proponents pointed out that external causes of death in any wild population (such as predators, infectious diseases, starvation, or lack of habitat) would tend to mask the effect of aging. This made logical sense. If all of the mice in a mouse population died from external causes by age 3 there would be no evolutionary benefit to that population from individual mice having the internal capability for living longer or from having any trait that only benefitted animals older than 3. Because different populations of the same species might have different external circumstances their needs for lifespan might be different. The lifespan needs of different species might be very different.

Observations suggested that this was possible. Populations of wild mice obviously survive even though individuals can only live to be about 3 years old under zoo conditions. Fruit flies are ubiquitous even though they only live about 50 days.

However, multiple competing theories based on this idea still exist and logical issues and evidence conflicts (Chapter 4) apply to all of them. For various reasons aging theories based on concept two also logically lead to the idea that lifespan extension is impossible (Chapter 3).

It is very important to notice that a key shift between concept one and concepts two and three concerns changing the emphasis between the success of *individual members* of a population (Darwin's concept one) and the success (non-extinction and growth) of a *population* of those individuals (concept two). Darwin's idea makes sense according to what was then known about biological inheritance. Massive increases in our understanding of biological inheritance (genetics) since Darwin and extensive multi-species evidence now support concepts two and three.

Three, a modification to concept two suggests that beyond a species and population-specific age there is actually an evolutionary *disadvantage* from *individuals having the internal ability to live longer*! The force of evolution in more complex species is therefore toward attaining *but not exceeding* a particular species and population specific lifespan. Therefore, in any given population the force of evolution is toward a particular *optimum* lifespan as opposed to minimum lifespan. Beginning about 1960 a series of more explicitly population-oriented evolutionary mechanics theories with names like *group selection*, *kin selection*, and *evolvability theory* appeared and increased support for population-driven evolution theories.

Concept three logically leads to the idea that aging is the result of a *life program* or biological mechanism that stages life events as a function of age and possibly additionally as a function of external circumstances. These programs are very common in animals and even plants. For example, puberty and menopause are programmed life events. Mating seasons common in mammals and other animals are examples of life programs that are synchronized to external events such as seasons.

This concept also logically leads to the idea that aging is treatable because it suggests that there is a single common cause (the aging program) that causes most cases of the age-related diseases and symptoms. For example, if for some reason we wanted to we could change an animal's age of reproductive maturity using hormone treatments.

Concept three is actually rather similar to concept two. They are both population-oriented as opposed to individual-oriented. They both modify Darwin's ideas. They differ in what could be considered a tiny numerical difference. At some species-specific age does the force of evolution toward living longer decline to nearly zero thus explaining the lack of additional lifespan or does it decline to an at least tiny negative value thus explaining the evolution of a biological mechanism that purposely limits lifespan? Theorists have been fiercely arguing over this hair-splitting detail for decades.

Concept three and the idea that we possess what amounts to a biological suicide mechanism very directly conflicts with Darwin's survival of the fittest idea and many people, especially those trained only in that idea, summarily reject it.

It is relatively easy to see that for any wild population there must exist some age at which every member would be dead from external causes (Concept two) but harder to see how there could be a population benefit from an organism design that internally limits individual lifespan. However, today there are at least a dozen different theories as to why this would be true (Chapter 3). My favorite is that internally limiting *individual* lifespan increases a *population's* ability to evolve and thereby adapt to *changes* in its external world.

Today there are two main evolutionary theories of biological aging called *programmed* aging (or adaptive aging) based on concept three, and *non-programmed* (or non-adaptive) aging based on concept two. The huge practical consequence is that non-programmed theories strongly lead to the conclusion that aging is itself an untreatable condition. In contrast, programmed theories strongly suggest that aging is itself a treatable condition and that lifespan extension in addition to healthier aging is possible. Both theories support many of the observations about aging that conflicted with concept one as described in Chapter 2. Programmed aging theories provide a better fit to many additional observations (Chapter 4).

Another major practical consequence is that the two theories suggest radically different concepts regarding the nature of the biological mechanisms that cause massively age-related diseases like cancer and heart disease and therefore lead to somewhat different paths for researchers looking for ways to prevent or treat these diseases.

Non-programmed theories and some programmed theories suggest that lifespan is simply a genetically determined function of age. However, some programmed theories suggest that aging is the result of an adaptive mechanism (Chapter 6) that can adjust organism lifespan in response to the detection of external conditions that affect optimum lifespan in addition to age. These conditions could include predation, starvation, severe environmental conditions, and other external stress factors that could affect a population's need for lifespan. This idea is supported by extensive evidence and shows how exercise and diet can affect lifespan.

Aging is not just a problem for "old" people (Chapter 2). Death rates for 40-year-olds are substantially higher than for younger people. We cannot really understand and most effectively treat age-related diseases without understanding aging and the competing evolution concepts lead to drastically different concepts regarding the nature of those diseases.

As this book will summarize, current science and many observations (Chapter 4) greatly favor programmed aging and thereby lifespan extension but many *non-science factors* (Chapter 7) favor non-programmed aging and oppose lifespan extension. For example, the existing health-care system conflicts with the idea that aging is treatable. These factors are the primary reason there is still no wide scientific agreement on even the general nature of aging.

I have been working in this field for about 20 years. Near the beginning of this period there was a strong consensus among gerontologists to the effect that concept three (and programmed aging) was "impossible" on evolutionary mechanics grounds and therefore scientifically ridiculous (Chapter 3). Since then, many gerontologists concede that concept three and programmed aging are possible and there is now substantial investment in research based on programmed aging principles (Chapter 10).

Anti-Aging Medicine Overview

The existing huge health-care system (Chapter 5) has evolved over the centuries based on two assumptions:

First, ***every disease (including the age-related diseases) is at least potentially treatable***.

Because only some people are affected by any particular disease it is obviously possible to avoid the disease. By looking at the differences between those who develop the disease and those who do not, we can derive clues regarding treatment and prevention. Researchers are exploring development of treatments for even very rare diseases that affect very few people.

Second, ***aging is itself untreatable***.

Aging affects everyone. Everyone eventually dies of aging even if they escape other causes. The longest living person (credibly identified so far) was Jeanne Calment who died in France in 1997 aged 122 years. Aging is still widely seen as an inescapable human condition. In addition, age-related conditions tend to be seen as less treatable and more "normal" than diseases.

However, it is also clear that like height and many other traits, aging varies substantially between individuals. Some 70-year-olds look, act, and suffer from age-related diseases as if they were 60, others as if they were 80. We could study and exploit the differences. In addition, there are drastic differences in aging and lifespan between mammal species that can be (and are being) studied. Finally, some species apparently *do not age* and there is now substantial direct evidence of aging programs in various species (Chapter 4).

Medicine and healthcare are similar but not identical in developed countries. This book is mainly concerned with the medicine, research, and health care situation with respect to aging in the United States.

Medicine is mainly about humans. Evolutionary mechanics theories are mainly about all of the other species that make up Earth's biosphere and include addressing questions like: Why do naked mole rats live about ten times longer than similar rodents? and; How does the evolution process differ between bacteria and more complex organisms? and; Why do some clams and some trees have very long lifespans?

Some people reading this book may not be very interested in reading about the seemingly interminable academic arguments concerning evolution and aging. Also, these issues, as we could guess from the lack of scientific agreement, are complicated. If this describes you, feel free to skip Chapters 3, 4, and 8 and proceed to the more practical chapters concerning anti-aging medicine and personal efforts that can be made toward living longer and healthier lives.

However, it is important to note that to most effectively and safely pursue an anti-aging path you are going to need to consult with a doctor who is familiar with your personal medical situation.

This is complicated by the fact that many physicians still believe that lifespan extension is impossible and the existing health system is largely oriented around this idea.

If on the other hand you are interested in extremely important unresolved scientific issues and have some training in biology, read on!

References

Anti-Aging Medicine: How we can Extend Lifespan and Live Longer and Healthier Live – Paperback version – Theodore C. Goldsmith ISBN 0978870964 (2021) print edition.

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***Aging Info* (http://www.azinet.com/aging) links to many resources on aging.**

Programmed Aging Theory Info (http://www.programmed-aging.org/)

See full-text book for the complete reference list.