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Artificial Intelligence, Deep Aging Clocks, and the Advent of 'Biological Age': A Christian Critique of AI-Powered Longevity Medicine with Particular Reference to Fasting

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Abstract: I argue that the use of artificial intelligence (AI) in longevity medicine to slow human aging encourages individuals to see themselves as managers of their own biology. While such a stance is not entirely unwarranted, it may nevertheless preclude other perspectives of the body as it relates to spiritual formation: namely, the Christian discipline of fasting. Using a christological anthropology informed by Karl Barth, I explore the potential impact of AI-fueled markers such as deep aging clocks (DACs) and the related technological construct of "biological age" (as distinct from chronological age) and how this construct might impact the Christian practice of fasting.

Keywords: artificial intelligence (AI); aging; longevity; deep aging clocks (DACs); Incarnation; fasting; biohorology

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1. Introduction

In this article, I offer a Christian assessment of new technological developments in artificial intelligence (AI) related to the rapidly expanding field of human aging research. I pay particular attention to interpretations of human embodiment implicit in the latest quest to mitigate the effects of aging through the use of this technology. After briefly discussing the recent history of anti-aging science, its rationale, and the contribution of AI to its growth, I will offer one brief Christian interpretation of these new developments. This particular interpretation will be informed by two core doctrines in the history of Christianity—the Incarnation of Jesus Christ and the resurrection of the body. I will argue that the project of life extension is deeply ambiguous. Moreover, I suggest that while a Christian perspective should neither wholly embrace life extension nor completely reject it, it can highlight the ways in which AI-driven anti-aging technology may foster a hostile stance toward the human body and its limitedness. It also threatens to undermine the value of the finite body for Christian spiritual practices that shape human desire such as fasting.

The quest to remain perpetually young is likely as old as the emergence of *Homo Sapiens Sapiens*; its unfolding story is marked by a bizarre history that includes everything from ancient meditative techniques, fountain legends, and the search for potable gold, to xenotransplantation (monkey gonads), hyperbaric oxygen chambers, ketogenic diets, nootropic smart drugs, and pulsed electromagnetic field therapy. Though the efficacy of these recent biohacks is questionable, most developed countries have experienced a near doubling in life expectancy over the last century, due in large part to improvements in public health and medicine (Riley 2001). Americans born at the beginning of this century can expect to live to nearly 80 years on average, compared to just 47 years in 1900, though COVID-19 will inevitably impact longevity figures in the near future, especially among marginalized communities (Center for Disease Control 2010, Table 22).[1] However, longer lifespans have not been accompanied by longer *health* spans, as such gains have led to an older society characterized by significant increases in age-related maladies such as Parkinson's, high blood pressure, dementia, and heart disease. A defining characteristic

of our age seems to be that we are both younger longer and older longer. We may be on the precipice of a "mass geriatric society", where a growing percentage of the US population is expected to live to the age of 85 and beyond. This will include a much greater likelihood of experiencing the irrevocable progression of chronic illness, increased fragility, and disability lasting several years (President's Council on Bioethics 2005). A Rand Corporation study indicated that this particular trajectory for the chronically ill accounted for roughly 40 percent of all deaths (Lynn and Adamson 2003).

These demographic changes continue to place enormous burdens on a US healthcare system that is still adapting to these changes at the end of life. The very system that has contributed to the increase in life expectancy is now confronted with the burden of its own success as waves of baby boomers require treatment for the diseases that accompany old age. Alzheimer's disease and dementia cost Medicare and Medicaid over USD 200 billion in 2020 and have been proven more expensive to treat than cancer and heart disease (Alzheimer's Association 2020). Indeed, the number of individuals with Alzheimer's is expected to rise from 4 million in 2005 to nearly 14 million by 2050, at an estimated cost of USD 584 billion (Alzheimer's Association 2020). Moreover, it is generally recognized that mitigating any single disease, such as Alzheimer's or the most common forms of cancer, would at best add a few years to life expectancy, while doing little to assuage the population growth of those 85 years and older (Olshansky et al. 1990). These findings have led to the formation of the Longevity Dividend Initiative Consortium (LDIC), a group of epidemiologists, gerontologists, economists, and others, who, in the interest of the long-term financial sustainability of the US healthcare system, argue for more resource allocation for studying human aging itself (Olshansky et al. 2006). The LDIC draws on a growing body of evidence indicating that human aging can be decelerated. They assert that shortening the period of decline before death (i.e., morbidity compression) will enable older individuals to contribute to their communities and society as a whole, creating wealth for such individuals and the nations they inhabit (Bloom and Canning 2000).[2] Since aging is the underlying cause of all age-related diseases, this approach purportedly makes good sense from scientific, economic, and public health perspectives.

2. Slowing Human Aging

Recent laboratory evidence suggests that human aging may be attenuated. Over the last two decades scientists have extended the healthy lifespans of nematode worms, fruit flies, and mice by slowing the aging process through genetic engineering, caloric restriction, and other techniques. Scientists are now searching for human analogues, and limited human trials have shown tissue-specific age-reversal in older adults as measured by DNA methylation (Daly 2021, pp. 46–69).[3] Though anti-aging research has moved from legend to the laboratory, it is far from certain that even a modest deceleration of aging will produce the desired effects as expressed by the Consortium. There is no agreement on whether the main goal of life extension should be to focus on significantly extending healthy life (adding years to one's life), or to compress the period of morbidity (adding life to one's years). Transhumanists, for example, seem uniformly committed to the former—including immortality by uploading the mind/consciousness to a more reliable substrate—while those of the Longevity Consortium are obviously committed to the latter.[4] The more hyperbolic claims of some transhumanists notwithstanding, both scenarios interpret human aging as a condition demanding our best technologically mediated manipulative efforts. While both perspectives see aging as the problem, the more ambiguous scenario, ethically speaking, concerns the morbidity compression approach envisioned by the LDIC, though defenders of this approach acknowledge that the human lifespan might also be extended beyond the biological limit of 120 years (Juengst 2004).

Though, as mentioned above, scientists have developed several techniques for slowing aging in nematode worms, fruit flies, and mice, developing analogues for human beings still faces considerable challenges. However, the use of narrow or "weak" AI has shown promise in enabling researchers to process large groups of data and may prove instrumental in untangling the intricate processes of human aging by identifying drug targets

(Aliper et al. 2017)[5] and developing therapeutics to enhance both the life and health span (Moore and Raghavachari 2019). I discuss these developments briefly here before making a general assessment and offering a Christian interpretation with particular attention to embodiment.

3. Towards an Aging Theory: Biological Age (BA) and Deep Aging Clocks (DACs)

Gerontologists and those studying aging across various scientific disciplines concede that there is no agreement concerning the ultimate cause of aging. Moreover, developing any conclusive theory of human aging is only further complicated by our inability to even quantify, much less define, human aging. Despite the growing number of human aging biomarkers—epigenetic changes, telomere attrition, and molecular clocks, among others—there is currently no single theory of aging to account for these various biomarkers in any coherent fashion. Hence, without any general agreement as to what constitutes aging biologically and how its progression is to be measured, it becomes extremely difficult to draw any substantive conclusions on the potential benefits of particular therapies. We have the means "to inspect and manipulate biological systems with precision unavailable to our predecessors, yet the mystery of aging remains unsolved" (Galkin et al. 2020, p. 1). Hence, there is a push to develop ways to measure biological aging in humans, a task that will require the use of AI to manage the multiple biomarkers already associated with aging. Indeed, the nascent, but rapidly developing field known as "biohorology", a science devoted to measuring the passage of time in living organisms, is heavily dependent on AI.

Aware of the growing disparity between lifespan and healthspan, and the economic burden of treating multiple comorbidities of old age and later life, researchers such as Alex Zhavoronkov are aggressively promoting the use of AI to bring longevity medicine into the realm of everyday clinical medical practice. Zhavoronkov has noted the potential for digital neural networks to exploit longitudinal data of both healthy individuals and those with diseases, which, with the assistance of deep learning, will "learn" the difference between aging and disease. He believes this AI-driven knowledge will lead to potential applications for risk prediction and even treatments to modulate aging itself. Like others in the field of aging research, he notes that digital neural networks are uniquely positioned for integrative analysis with massive data sets and multi-omics data (e.g., genomic, epigenomic, proteonomic, and transcriptomic data).

Recently, for example, AI has been employed to estimate an individual's biological age (BA) which is, purportedly, a better predictor of one's mortality than the presence of disease or frailty, or even one's chronological age. In particular, deep learning—a unique form of machine learning (ML) that employs multilayered neural networks—was used to establish deep aging clocks (DACs) to calculate a person's biological age from a routine blood sample (Zhavoronkov and Mamoshina 2019).[6] If human aging is caused by a multitude of damage-accumulating processes occurring simultaneously, then BA is "unlikely to be a property of objective reality but should be treated as an artificial construct".[7] (Galkin et al. 2020, p. 2) This "artificial construct" includes heavy reliance on both a scientific consensus of the core processes associated with aging, while also accounting for (ideally) socioeconomic and cultural differences among people (ibid.). Thus, there is hope that "accurate BA measurement could bring around new hypotheses on the nature of aging and be the first step towards a paradigm shift in biogerontology" (Galkin et al. 2020, p. 2). Moreover, it is hoped that biohorology, combined with AI-assisted deep learning techniques "could be used to increase our understanding of aging processes and to design geroprotective interventions" (ibid.). Interestingly, from this particular biohorological perspective, the definition of chronological aging is considered "trivial", as BA remains "a fluid, borderline placeholder concept used to refer to the time-dependent component of an organism's overall health condition" (ibid.). There are several potential uses for DACs in aging research, including dementia screening and staging, age-personalized immune-oncology treatment, age-personalized vaccines, mortality prediction, preventative medicine, and the generation of synthetic data, to name but a few (Zhavoronkov and

Mamoshina 2019; Galkin et al. 2020). The use of multimodal aging clocks and other clock ensembles trained on all accessible data types may one day even serve as a "digital twin" for a patient, whose likeness can be moved forward or backward in time through the use of generative adversarial networks (GANs), another type of AI algorithm (Zhavoronkov and Mamoshina 2019, p. 549; Galkin et al. 2021a, p. 1253).

As mentioned above, though the calculation of one's biological age may bring about a paradigm shift for the field of gerontology, some believe that this particular application of AI should be integrated into the future of clinical medicine. Determining one's biological age through DACs, says Zhavoronkov et al. (2021, p. 6), "should become an essential part of the physician's tool kit, enabling AI-supported recommendations to promote long and healthy lives". More generally, he observes:

> AI-powered longevity medicine will facilitate the discovery of drug targets for specific individuals, the identification of tailored geroprotective interventions and aging and longevity biomarkers to enhance the study of aging and disease trajectories, and the identification of interventions that may help slow down or even reverse aging-associated biological, physiological or psychological processes (Zhavoronkov et al. 2021, p. 6).

Zhavoronkov recognizes that longevity medicine will need to be practiced by physicians with the requisite clinical protocols and diagnostic and treatment guidelines for formal recognition as a branch of medicine. As such, he recognizes that "aging needs to be monitored and treated as a medical condition", with appropriate studies demonstrating the efficacy and safety of specific interventions (ibid.).

Zhavoronkov's aspirations do not lie on the fringes of legitimate medical research; longevity medicine is moving to the mainstream. In August of 2018, the National Institute on Aging (NIA) convened an interdisciplinary workshop entitled "Contributions of Artificial Intelligence to Research on Determinants and Modulation of Health Span and Life Span" to explore the use of AI. They aspired to "untangle the complex physiological process(es) that modulate health and lifespan" in order to "accelerate the discovery of novel therapeutics for healthy aging" (Moore and Raghavachari 2019, p. 1). The workshop concluded:

> AI approaches appear to be extremely valuable for integration of genetic and cellular data from human and other species and for modeling biological processes associated with aging. Such analyses could potentially resolve several unanswered questions currently pending in aging research.

Once again, the hope is that collaborative work for mining genetic and multi-omics data will overcome current hurdles with existing analytical strategies, leading to "novel discoveries to enhance health and life span" (Moore and Raghavachari 2019, p. 11). The development of DACs to measure biological age may be a significant step along this path.

Certainly, recent success with the AI-driven BloodAge has already demonstrated impressive predictive abilities concerning mortality in COVID-19 patients and may prove useful in helping hospitals determine risk stratification during prolonged public health crises, like a pandemic. Here, one finds a concrete example of the potential benefits in relying on one's biological age (BA)—or in this case, one's BloodAge—as a better determinant of a patient's mortality. Though COVID-19 has been classified as a gerolavic infection—i.e., harmful (from the Greek *epilavís*) to the old (Gk. *géros*)—chronological age may *not* be the best determinant of survival in older patients, due in large part to the variability of the human aging rate and a wide variety of associated comorbidities. Some people just age faster than others. Recently, the AI-powered Deep Longevity calculated the biological age (BA) of over 5,300 COVID-positive patients across 11 public New York hospitals, utilizing the deep learning neural network BloodAge to analyze over 40 blood biomarkers for each patient. Those whose BA was higher or lower than their chronological age were classified as "overagers" or "underagers", respectively. "Overagers" were considered to exhibit accelerated aging (Galkin et al. 2021b). Significantly, their findings indicated that the *pace* of

aging had a higher impact than a patient's *chronological age* on the lethal infection outcome (ibid.).

> These findings illustrate that biological age may be more informative than chronological age for mortality prediction. The correction for BloodAge may account for individual differences in the aging process and quantify the intuitive understanding of a patient being chronologically old but looking young, or the opposite (Galkin et al. 2021b, p. 11).

In this particular instance, BA proved a better predictor of mortality for COVID-19 patients than chronological age. A similar study carried out in Germany and Austria demonstrated the effectiveness of AI in predicting the survival of COVID-19 patients. By analyzing blood samples with the use of AI, researchers identified several specific inflammatory proteins closely associated with the risk of death and other proteins associated with survival (Demichev et al. 2022).[8] A machine learning model based on a single timepoint measurement of these specific proteins was developed and tested on 24 critically ill COVID-19 patients, correctly predicting the survival of 18 of 19 patients and fatality for all of the patients who died (five of five). The potential clinical application of AI-powered predictive data of this sort stands to impact the practice of medicine dramatically and will likely become an object of bioethical discussion in the near future.

When it comes to determining one's biological age however, one need not wait for a disease diagnosis; AI is already here. Young.AI, with its claims of "Longevity Science that Works for You", is a free app that can easily be downloaded onto any smartphone. It offers a personalized system that analyzes one's biological data by tracking several biomarkers that help users to "control your aging and extend your longevity".[9] It is based in large part on a blood sample analyzed by the aforementioned deep learning neural network BloodAge, which, according to Young.AI, is "your real age". In addition to calculating one's "photo age", "psychological or mind age", and "behavior age", the app also creates a personalized longevity-enhancing program, allowing users to track, highlight, and eliminate unhealthy habits and behaviors. Young.AI boasts of using deep neural networks "to highlight the habits you need to change, splitting them into small, easy to do tasks". It is possible to upload even more data to improve one's age prediction. This is another practical application of biohorological information, encouraging its users to "Hack Your Longevity and Improve Your Results".

4. What Is Different about AI?

Before considering these developments from a Christian perspective that takes its guidance from the Incarnation and bodily resurrection, a few observations may be made regarding the application of AI to longevity research and the possibility of slowing human aging. First, the potential applications of AI in researching human aging have clear benefits in helping us understand the complex process of human aging and in promoting healthy aging by allowing individuals to track several biomarkers that measure one's overall health. Predicting mortality with COVID-19 positive patients may also prove useful during times when demand greatly outpaces medical resources, though such a grim task would not be without controversy. Moreover, processing and sharing various omics data across various scientific disciplines ought to spur collaborative efforts in helping us better understand various diseases associated with aging. The initial results of AI-driven aging-attenuation technologies do seem promising in several areas, whether it be dementia screening and staging, age-personalized immune-oncology treatment and vaccines, mortality prediction, or preventative medicine.

There are of course ethical concerns that, once again, would hardly be unique to a Christian perspective on slowing aging through AI. The usual list of suspects here are privacy and information bias, the "black box" challenge regarding machine learning, the potential of AI to contribute to ageist and ableist interpretations of persons, justice and accessibility of the technology,[10] and the subtle power by which predictive knowledge of this kind can influence human behavior in ways that are inimical to human flourishing.

For instance, there are examples where judges put more faith in the use of an algorithm (COMPAS)[11] to assess the risk of recidivism than in the agreements arranged between the defense and the prosecution (Coeckelbergh 2020, p. 6). The algorithm also led to controversy as those predicted to reoffend but did not were disproportionately Black (Fry 2018, pp. 71–72). There are clear implications for healthcare systems (Panch et al. 2019). A core philosophical debate in data set collection concerns whether data sets should *reflect* current reality (the mirror view) or try to *change* reality in ways that are more just (Coeckelbergh 2020, chp. 9). Scientists are at least aware of the potential for bias in collecting population data, given especially that human aging is a universal phenomenon.

A related issue is machine learning and the "black box" phenomenon. While programmers know the architecture of the network, it is not clear to others how decisions are reached between input and output.[12] In this "unsupervised" machine learning, training algorithms make their own categories, rather than looking at a predetermined variable selected by the programmer.[13] The hope is that the AI may find patterns that are otherwise fundamentally inaccessible, patterns that domain experts have either not yet identified or make no sense from a human perspective. However, a certain opacity is introduced here, that might only be made clear through the development of transparent AI. Little wonder then that philosopher Mark Coeckelbergh refers to statistics and the big data usage in (narrow) AI as "the new magic" (Coeckelbergh 2020, p. 94).

Here, we might ask, what, or to whom are we entrusting our bodies, our future? Is there a difference between manipulating certain genes with CRISPR-Cas9 and utilizing big data with machine learning, other than differences in transparency? Are these two different kinds of knowledge or is the latter merely information? Margaret Boden reminds us that AI lacks our understanding of relevance (Boden 2016). In addition, it also lacks "understanding, experience, sensitivity, and wisdom" (Coeckelbergh 2020, p. 90). Moreover, while scientists press forward in their quest to understand and control human aging, such efforts are not without social consequences. Our understanding of aging itself, and what it means to grow old, will likely be influenced by our attempts to measure it more precisely and bring it under our control. It is difficult to envision a future where any success in forestalling aging does not imply a negative judgment on the aged, especially on those who have not aged well. Moreover, as feminist, disability, and queer theorists have pointed out, such judgments are disproportionally aimed at women (Sontag 1972; Holstein et al. 2011).

In addition, there are subtle dangers in the use of AI for aging research, especially the calculation of one's biological age through the use of DACs. This concerns the danger of abstraction and the temptation to alter one's actions in light of such abstractions. While it is likely impossible to make any sense of the world without making abstractions, some may have more impact than others. There is something Platonic here when the AI estimation of one's biological age is interpreted as one's "real age": for one's biological age is actually an elaborate and opaque statistical abstraction from the messy material world, and that it may mean more than one's chronological (or actual?) age. Either way, though AI puts science behind the well-worn trope "age is just a number", abstraction is never a neutral process. The advent of AI-powered BA will have implications for human embodiment and will be the focus of a brief Christian assessment of its use in aging research. Before offering this assessment however, it is worth briefly considering how the advent of BA might impact our behavior.

Of course, BA may very well encourage some individuals to pursue a healthier lifestyle. However, it might be seen as another guilt-inducing burden. Or, conversely, a BA score considerably lower than one's chronological age might tempt some to relax or abandon disciplines that have served them well or leave one with the impression that they have more time to live than they otherwise thought. There is a subtle danger here as well, as BA is indeed more than just a number; it is laden with formative and predictive power and has the potential to put us into a self-inflicted prison of the possible, inducing a degree of paralysis or angst, whether higher or lower than our chronological age. This phenomenon is

already apparent for those who, having learned of a troubling family genetic history, press for aggressive preventative measures to head off the potential development of diseases like cancer. Hence the term "previvor" (Mukherjee 2021). In other words, as the existentialists remind us, there is the danger of living life in an "as if" mode, of abstracting one's life from one's lived body. In this final section, I examine the nature of the aging body as understood by contemporary AI research in light of the Christian doctrines of the Incarnation and the resurrection of the body, concluding with some brief reflections on how the use of BA might influence Christian faith and practice by reference to the ancient Christian discipline of fasting.

5. One Christian Perspective on AI-Driven Aging Research

It should be noted that what follows is one *possible* Christian assessment; there may be as many Christian approaches to AI-assisted aging research as there are Christian denominations. Moreover, each denomination will likely have a variety of views on particular doctrines ranging from conservative to liberal (Mercer and Trothen 2021, chp. 3). In addition, Christianity in general is capable of accommodating a wide variety of perspectives on the morality of slowing human aging, ranging from sharp rejection (Radner 2016) to enthusiastic (though not uncritical) endorsement (Christian Transhumanist Association). This Christian perspective with a particular attention on embodiment will be informed by the Incarnation of Jesus Christ and the resurrection of the body.

Historical Christianity confesses the Incarnation of the Son of God, the Divine Logos, who was made flesh by the Holy Spirit (John 14). Historically, the church has confessed that Jesus Christ is both fully God and fully man—two natures, united in one person. This means that Jesus lived and walked on this earth as a human being with a body and a soul, without, at the same time, ceasing to be fully divine. In his enormously influential *Church Dogmatics*, the Swiss Protestant theologian Karl Barth (1886–1968) argued that the human nature of Christ is not to be determined by our humanity, but vice versa. In other words, in depictions of Jesus Christ as attested in Scripture, Christ's humanity confronts ours, giving us a picture of humanity as it is meant to be. Jesus is the "Archimedean point" from which true knowledge of humanity might be established, though there are no simple, straight lines from Jesus' human nature to ours (Barth 1956–1977, vol. 1/2, p. 22). Barth is singled out, here, for his extensive treatment of human existence in time as a feature of Jesus Christ as "Lord of Time" (Barth 1956–1977, vol. 3/2, p. 437 ff.). In light of the Incarnation, Barth insisted that our natural, bounded lifespan is a sign of our divine determination as finite creatures (Barth 1956–1977, vol. 3/2, p. 439). Hence, "the existence of the man Jesus in time is our assurance that time as the form of human existence is willed and created by God and given to man" (Barth 1956–1977, vol. 3/2, p. 552). Not only was Jesus' embodied limitedness necessary for him to die on the cross, but his finitude also means that human mortality is proper to our existence and should not be regarded as intrinsically negative or evil. As embodied souls and ensouled bodies, we are finite beings.

Though Barth was certainly sympathetic to the desire for longer life as a covenant partner with God, he was also acutely aware of the reality of sin as understood in light of the real man Jesus, whose soul was in perfect submission to God, and whose body was perfectly ruled by his soul.[14] Sin, said Barth, manifests itself as both sloth (*Trägheit*), a disruption in the proper order of body and soul, and anxiety (*Sorge*), understood as a disruption of our right relationship to our temporality. In our sloth, we are unable to rest in the givenness of our own embodied being and allotted time, but rather fret over our limited existence by trying to "arrest the foot which brings us constantly nearer to this frontier" (Barth 1956–1977, vol. 4/2, p. 468). In our anxiety (*Sorge*), an allotted span becomes unbearable, fueling a frenetic, ceaseless activity, including our quests for longer life (Barth 1956–1977, vol. 4/2, p. 463). From Barth's Christocentric perspective, attempts to slow aging through AI technology might be seen as products of both sloth and anxiety, though the question remains as to whether *every* such attempt to slow aging must be understood as such. Nevertheless, Barth's Christology may prove useful to any

larger consideration of human enhancement from a Christian perspective insofar as Jesus Christ presents us with the picture of humanity as determined by God. Though great care is required in drawing out the implications Jesus' humanity has for our humanity, the Incarnation bespeaks a divine validation of human creatures *as* finite human beings.[15]

The resurrection of the body is no less important for a Christian understanding of embodiment. The apostle Paul speaks of bodily resurrection as witnessed to and established by the resurrection of Jesus Christ (1 Corinthians 15). This new body is given by God (15:38), and, as Paul explains, is marked by a series of contrasts with our original bodies. The old body is perishable, the new is raised imperishable (v. 42); the old is sown in dishonor, the new is raised in glory (v. 43); the old is sown in weakness while the new is raised in power (v. 44); the old is sown a physical body, the new is raised a spiritual body (v. 45). Two observations are relevant here. First, the "perishable . . . imperishable" ("*phthora* . . . *aphtharsia*") distinction does not name a quality but a *process*. Anthony Thiselton has noted the significance of this:

> The word *phthora* [perishable] denotes the process of *decreasing capacities, increasing weakness*, and *approaching exhaustion*, which are all too familiar to those of us in our seventies, eighties, or nineties. These finally reach stagnation and death. The term *aphtharsia* [imperishable] in *Paul's context* does not denote the static quality of "being immortal", but the *reversal* of decreasing capacities, that is, increasing ones" (Thiselton 2015, p. 361).

The resurrection body is one that no longer endures the slow decline of age.

Second, the term "spiritual body" is not a contrast to a material or physical body but is best understood as a body that is constituted and enlivened by the Holy Spirit (Thiselton 2015, p. 363; Wright 2003, pp. 347, 354). Indeed, the postresurrection appearances of Jesus in the Gospels offer a clue to the nature of the resurrection body.

Bodily resurrection reminds Christians that human life is indeed limited but also that the body will not be cast off or discarded in the eschaton. Resurrection is not reincarnation, nor is it mere resuscitation. As Cardinal Walter Kasper has noted, "the body is so vital to humanity, that a being without a body after death is unthinkable" (Kasper 1976, p. 150; Keenan 2014). Though Christianity has at times sounded Platonic, the Incarnation and resurrection are reminders that embodiment is a core feature of our identity and what it means to be a human being (Hrynkow 2019, pp. 178–79).

From this particular vantage point, there are several things that can be said about the AI-powered quest to bring human aging under control. First, this project, like much of modern medicine, is Cartesian. This may seem an odd claim to make when contemporary science tends toward a reductionistic materialism. However, insofar as there remains some distinct locus of selfhood, some intentional "I" that is responsible for my body as an object, the current technological project aimed at modulating aging is indeed informed by a dualism where one's deep desires (and fears) stand over against one's body. As Sarah Coakley observes,

> This might be said to be the *dominating* 'paradox' of bodiliness in the privileged post-modern West: does reductive scientific physicalism really reign, or does a stark dualism still dominate our obsessions with manufactured fitness and sexual youthfulness? (Coakley 2015, p. 1).

Indeed, Gerald McKenny has also noted that because of the triumph of the Cartesian self in the context of modern medical breakthroughs, we are constantly tempted to treat the body as subservient to the unencumbered "naked will" (McKenny 1997, p. 199). When scientists aim to modulate aging, it seems that aging itself has become a problem. We are thus encouraged to adopt a managerial stance towards the aging body. In this paradigm, aging is primarily viewed as a failure. If AI-driven approaches prove successful and become widely available, aging may be interpreted as a failure of human responsibility and resolve, a failure to utilize such technology for the greater economic and social good, and a profoundly human failure at that.

If the AI-fueled quest for longevity is dualistic or Cartesian, it is also gnostic, insofar as the body itself is seen as the heritage of undirected evolutionary forces and as raw material for the naked will. It is gnostic to the degree that it harbors a distrust of the materiality of the body, of its operations and many deleterious processes that continue to elude scientists. In this economy, AI-assisted gerontologists, evolutionary biologists, chemists, and programmers are the "new gnostics". These are the elite who have the knowledge (*gnōsis*) to bring about the redemption of humanity from old age, decrepitude, and dependency by "untangle[ing] the complex physiological process(es) that modulate health and lifespan", solving the great mystery of aging itself (Moore and Raghavachari 2019, p. 1). This new priesthood offers an AI-mediated salvation (temporarily, at least) from the ravages of time.

None of these reflections, however, should be interpreted as an implicit—much less explicit—rejection of the use of AI to slow aging on Christian grounds. If AI is successful in helping compress the period of morbidity before death, and even extend the healthy lifespan, Christians may indeed welcome and even participate in such developments as a creative way of bringing a degree of redemption to a fallen world that awaits a final redemption in the eschaton (earthly immortality, however, would be problematic as a denial of bodily resurrection). It is however important to point out that this AI narrative of redemption is limited by a larger, transcendent salvation, mediated through the risen Christ who did not remove the vulnerability of aging, but entered into it and suffered death for the sake of the world. Moreover, Christianity has a long tradition of caring for the weakest and marginalized, which has always included providing care for the body, a practice that is grounded in the Incarnation, where God became weak and marginalized.

From this particular Christian perspective, caution in AI-assisted aging attenuation is warranted. Instead of asking "How far is too far?" or "What lines should Christians not cross?" Christians should consider whether or not the use of data from DACs might foster a Cartesian-like "management" attitude towards the aging, declining body, which runs counter to the picture of human embodiment as revealed in the Incarnation and resurrection. Will the use of this technology foster an attitude of sloth (*Trägheit*) and anxiety (*Sorge*) with one's body? Will AI enable or diminish our mandate to care for the aged or possibly redefine what counts as care? Will Christians be as inclined to take as many risks for the cause of justice, or to "take up one's cross?" (Luke 9: 23–25)[16] These questions merit greater investigation.

Finally, I will briefly consider how various Christian practices might be influenced by the development of biological age, such as the neglected ancient Christian discipline of fasting. The Incarnation also informed the fasting of the Desert Fathers as a moral project in which the body was heavily implicated in the reformation of one's soul, even as the body benefitted from the soul's reformation. Contrary to what is often asserted, the Desert Fathers were not at war with the body but were at war with the disordered desires of the soul. Through fasting, they sought to bring the soul in submission to God *through* the body, not solely in spite of it. The body and its desires were useful for refining the soul. Rather than seeing the body as merely an instrument of the soul, as an object of one's desires, the body and the impulses and desires arising from it were accorded the role of *instructor*, in order that one's embodied soul might be more fully aligned with the will of God.

St. Antony (251–356) was the paradigmatic figure of the desert ascetic, who, in denying the body through fasting, was able to come face to face with his own recalcitrant, twisted will. The goal of fasting was not primarily to transform the *body* (though this often occurred) but was a first step in bringing one's body and soul into their proper order: the soul being submitted to God and the body in submission to the soul. Though the body was meant to serve the soul, attention was first directed towards subduing the impulses and distractions of bodily needs and desires. Here, the body is the instructor. However, Antony also believed that the body could be transformed to that of Adam's prelapsarian state in the Garden of Eden: specifically, by slowing down the aging process, regaining longevity enjoyed by the biblical patriarchs (Genesis 5–11). St. Antony lived to 105 years of age,

though that is hardly the point. Longevity was never the primary goal: it was understood as the byproduct of a moral endeavor.

The project of life-extension—especially as it concerns various forms of biohacking—has been called the "new asceticism", which views the body largely as a managerial project (Juvin 2010). The philosopher–statesman Hervé Juvin has argued that in the new asceticism, the body becomes everything. This new asceticism confirms "that the body has become a material, a plastic substance that should lend itself to being changed, modeled to project the desired image, my body is my own property, my own responsibility; I choose it, mark it, distinguish it, shape it to my will" (Juvin 2010). The advent of BA and the practices it inspires might also be likened to a new asceticism of sorts, judging by the Young.AI website, though of a kind that is quite different than that practiced by early Christians. It provides a theological lens through which to view contemporary attempts to mitigate aging.

Finally, I will briefly consider how the advent of AI technology, and the development of BA in particular, might impact Christian faith and practice, considering fasting in particular. Admittedly, fasting for many Protestant Christians is a lost discipline, even in Eastern Christianity. If a new asceticism informed by AI is coming, one with deep learning algorithms that know our bodies better than we do, it seems that the ancient forms of Christian fasting will remain largely unpracticed. The new asceticism sees the body as morally neutral at best, as capable of being shaped in ways to meet one's nearly limitless desires (or avoid one's deepest fears). However, it may tempt Christians to reject finitude and see aging itself as the enemy. Ancient asceticism saw the body as both friend and enemy (on account of sin and the Fall), where fasting was a way in which the body could become an instructor, where one could learn from the wisdom of the limited body. Indeed, the Psalmist asserts that rightly numbering one's days is a prerequisite for acquiring wisdom (Ps. 90:10). The use of AI to determine one's BA might render the wisdom of the body as less important. More extended reflection on the difference between BA through artificial intelligence and the wisdom of the body seems a worthwhile endeavor, though one beyond the scope of this article.

Even so, several have observed that Christianity already suffers from a discarnate spirituality "which tends to disdain bodily works and to be interested only in states of soul" (de Vogüé 1989, pp. 95–96). Indeed, Christians still need to be reminded that prayer is more than a spiritual exercise, but also a physical one, says Fr. Evan Armatas, including the direction one faces, one's posture, and even one's surroundings, because "a human person is not simply a soul trapped in flesh" (Armatas 2020, p. 15). There is some irony here, for recapturing the practice of fasting may enable Christians to become the kinds of people for whom a longer life may no longer seem quite as important, while at the same time shaping their bodies to live longer than might have otherwise been the case.

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Notes

1 Centers for Disease Control/National Center for Health Statistics, Table 22, "Life Expectancy at Birth, at 65 Year of Age, and at 75 Years of Age, by Race and Sex: United States, Selected Years 1900–2007", Available online: https://www.cdc.gov/nchs/data/hus/2010/022.pdf (accessed on 22 February 2022). Drops in life expectancy will inevitably impact Black and Latino populations more than others (Andrasfay and Goldman 2021).

2 Their language of allowing older individuals to remain "useful" is, admittedly, troubling. The LDIC envisions a modest decelaration of aging sufficient to forestall the onset of age-related diseases by approximately seven years (Olshansky et al. 2006, pp. 31, 32).

3 It should be noted, however, that there is no single theory of aging that earns wide support across the scientific community, much less agreement on how aging should be measured, though AI promises to change this.

[4] Not all who argue for radical life extension, including potential immortality, espouse transhumanism as a philosophy. Biomedical gerontologist Aubrey de Grey, for instance, argues for potential immortality while distancing himself from transhumanist philosophy.

[5] AI can be used to discover mimetics of existing drugs with known anti-aging properties, such as metformin and rapamychin.

[6] Deep learning is a specific form of machine learning (ML) that employs multilayered neural networks. These networks are composed of layers of computational units commonly dubbed "neurons", units loosely inspired by the behavior of biological brain neurons, whose connections can be strengthened through positive reinforcement. It is capable of handling very large training sets (Moore and Raghavachari 2019, pp. 7–8).

[7] "If there is indeed no singular process behind all the manifestations of aging, measuring BA is infinitely harder than in the case of single-source aging" (ibid.).

[8] The study examined 50 patients who were critically ill with COVID-19. A machine learning (ML) approach was used to study the levels of 321 different proteins in blood samples taken from these patients at 349 different timepoints and was able to find associations between the measured proteins and patient survival.

[9] https://www.young.ai/ (accessed on 20 February 2022).

[10] As one commentator noted, AI might become a tool for the "survival of the richest" (Rushkoff 2018).

[11] Correctional Offender Management Profiling for Alternative Sanctions.

[12] This contrasts with decision trees where humans can check and evaluate the accuracy of the AI, as the outputs are deterministic.

[13] Coeckelbergh astutely notes, however, that the terms "supervised" and "unsupervised" have little to do with the level of human involvement, since all AI is initially designed by human beings (Coeckelbergh 2020, pp. 84–90).

[14] However, Barth was no Cartesian. Though he could distinguish between the body and soul, he also referred to Jesus' humanity—and therefore ours—as an embodied soul and an ensouled body. Barth referred to this particular understanding of the human as a "concrete reality" or "concrete monism" (Barth 1956–1977, vol. 3/2, pp. 393, 399, 417).

[15] That Jesus was a man in no way suggests that being a man or identifying as a male is superior to being a woman or identifying as a female.

[16] See (Cole-Turner 2009) for a helpful discussion.

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