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Old by obsolescence: The paradox of aging in the digital era

Joan Llorca Albareda[1] | Pablo García-Barranquero[2]

[1]Department of Philosophy I, University of Granada, Granada, Spain

[2]Department of Philosophy, University of Malaga, Malaga, Spain

Correspondence
Joan Llorca Albareda, Department of Philosophy I, University of Granada, Campus of Cartuja, Granada 18011, Spain.
Email: joanllorca@ugr.es

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Abstract

Geroscience and philosophy of aging have tended to focus their analyses on the biological and chronological dimensions of aging. Namely, one ages with the passage of time and by experiencing the cellular-molecular deterioration that accompanies this process. However, our concept of aging depends decisively on the social valuations held about it. In this article, we will argue that, if we study social aging in the contemporary world, a novel phenomenon can be identified: the paradox of aging in the digital era. If the social understanding of aging today is linked to unproductivity and obsolescence; then there is a possibility that, given the pace of change of digital technologies, we become obsolete at an early chronological and biological age, and therefore, feel old at a younger age. First, we will present the social dimension of aging based on Rowe and Kahn's model of successful aging. We will also show that their notion of social aging hardly considers structural aspects and weakens their approach. Second, departing from social aging in its structural sense, we will develop the paradox of aging in the digital era. On the one hand, we will explain how the institutionalization of aging has occurred in modern societies and how it is anchored in the concepts of obsolescence and productivity. On the other hand, we will state the kind of obsolescence that digitalization produces and argue that it can make cohorts of biologically and chronologically young individuals obsolete, and thus they would be personally and socially perceived as old.

KEYWORDS

digitalization, obsolescence, paradox, social aging

1 | INTRODUCTION

Philosophy of aging is a diverse and complex field of research. In its beginnings, the debate was focused almost exclusively on whether or not this process is a disease and the benefits and harms of its conceptualization.[1] This discussion is still open today, and we find increasingly sophisticated arguments in the literature.[2] However, in recent years, the focus has broadened to other types of discussions that go beyond the pathologization of aging in itself. On the one hand, onto-epistemic questions have emerged, such as if there are biomarkers to measure aging objectively, if it can be conceived from any theory of health, if rejuvenation is a plausible scientific-philosophical concept or if it can be understood as a natural kind.[3] On the other hand, ethical and social questions begin to be articulated: whether aging is desirable, whether we have a moral duty to fight it, whether we can develop an ideal of good life in old age, or whether a longer life span is problematic at various levels.[4]

The enormous variety of positions and topics comprising geroscience has characterized it by its lack of consensus. However, this may not necessarily be a problem. Guillermain[5] believes that this plurality of voices can promote research into the aging studies from multiple areas and points of view. However, although there is no substantive agreement on what aging is, there are ideas and preconceptions that underlie much of the research in this field. Discussions about this process usually revolve around two aging concepts: chronological and biological.[6] We define them briefly as follows:

1. *Chronological aging* refers to the passage of time from a person's birth to a given date. This dimension does not reflect health conditions and only considers the passage of time of the living person measured in quantifiable units of time.
2. *Biological aging* refers to the result of the accumulation of a wide variety of molecular-cellular damage over time, leading to a gradual decline in capacities, increased risk of disease, and ultimately, death. This dimension does show how deterioration and attrition affect the health of the living and is extraordinarily variable depending on internal-external factors.

Nonetheless, the chronological and biological dimensions of aging, although important for understanding it, are not the only ones. Aging is not limited to the time we spend in the world and the decline we experience during a good part of our lives. It also involves a set of social meanings about what it is, the valuation we should have of this process, and what kinds of activities and tasks are appropriate at advanced ages. This is what we refer to as social aging. One of the best-known models that incorporate this dimension is *successful aging*, proposed by Rowe and Kahn.[7] Both authors argue that, although we should be aware of the biological deterioration accompanying aging, we can only age adequately if we combine it with good social conditions: interpersonal ties, spaces for autonomy, and active performance of valuable tasks.

The purpose of this article is to analyze, from the coordinates of social aging, a singular phenomenon that is taking place as a result of digitalization: *the paradox of aging in the digital era*. Since aging is socially bound to the notion of obsolescence, and digitalization tends to make us unproductive at a younger age, we will tend to be perceived personally and socially as old at biologically and chronologically very early ages. The argument will proceed as follows. We will start by showing how the model of successful aging incorporates social aging into geroscience studies. We will then turn to the criticisms it has received for its lack of structural understanding and argue for the need to understand social aging structurally. Finally, we will analyze what the paradox of aging in the digital era consists of. For doing so, we will follow three intertwined steps: (1) we will expose the institutionalization of life stages and how modern societies have been temporalized and chronologized; (2) we will then present how each of these stages is socially articulated around the concepts of productivity and obsolescence; (3) ultimately, we will argue that digitalization, due to technological acceleration, demands ever more complex skills and knowledge at an ever-faster pace of change.

2 | SOCIAL AGING FROM SUCCESSFUL AGING

2.1 | Rowe and Kahn's model

Successful aging emerged in the context of a dispute between two schools of thought, which held conflicting views on this process—the

[1]Caplan, A. L. (2005). Death as an unnatural process: Why is it wrong to seek a cure for ageing? *EMBO Reports*, *6*(S1), S72-S75; Hayflick, L. (2000). The future of ageing. *Nature*, *408*(6809), 267–269.

[2]de Winter, G. (2015). Aging as disease. *Medicine, Health Care and Philosophy*, *18*, 237–243; Schramme, T. (2013). 'I hope that I get old before I die': Ageing and the concept of disease. *Theoretical Medicine and Bioethics*, *34*, 171–187; Saborido, C., & García-Barranquero, P. (2022). Is aging a disease? The theoretical definition of aging in the light of the philosophy of medicine. *The Journal of Medicine and Philosophy*, *47*(6), 770-783.

[3]García-Barranquero, P., & Bertolaso, M. (2022). The machine-like repair of aging. Disentangling the key assumptions of the SENS agenda. *Theoria: An International Journal for Theory, History and Foundations of Science*, *37*(3), 379-394; Green, S., & Hillersdal, L. (2021). Aging biomarkers and the measurement of health and risk. *History and Philosophy of the Life Sciences*, *43*(2); Sholl, J. (2021). Can aging research generate a theory of health? *History and Philosophy of the Life Sciences*, *43*(2); Maung, H. H. (2021). What's my age again? Age categories as interactive kinds. *History and Philosophy of the Life Sciences*, *43*(1).

[4]Farrelly, C. (2023). Imagination and idealism in the medical sciences of an ageing world. *Journal of Medical Ethics*, *49*(4), 271–274; García-Barranquero, P., Llorca Albareda, J., & Díaz-Cobacho, G. (2023). Is ageing undesirable? An ethical analysis. *Journal of Medical Ethics*; Ehni, H. J., Kadi, S., Schermer, M., & Venkatapuram, S. (2018). Toward a global geroethics–gerontology and the theory of the good human life. *Bioethics*, *32*(4), 261–268; Langmann, E. (2023). Vulnerability, ageism, and health: is it helpful to label older adults as a vulnerable group in health care? *Medicine, Health Care and Philosophy*, *26*(1), 133–142.

[5]Guillermain, C. (2022). Is there a need for consensus in aging biology? *Biology & Philosophy*, *37*(6), 49.

[6]García-Barranquero, P., Llorca Albareda, J., & Díaz-Cobacho, G. (2023). Is ageing undesirable? An ethical analysis. *Journal of Medical Ethics*; Lemoine, M. (2020). Defining aging. *Biology & Philosophy*, *35*(5), 46; Nathan, M. J. (2021). Does anybody really know what time it is? From biological age to biological time. *History and Philosophy of the Life Sciences*, *43*(1).

[7]Rowe, J. W., & Kahn, R. L. (1987). Human aging: Usual and successful. *Science*, *237*(4811), 143–149; Rowe, J. W., & Kahn, R. L. (1997). Successful aging. *The Gerontologist*, *37*(4), 433–440.

former being focused on loss and the latter on gain. On the one hand, *the theory of disengagement*[8] postulates that with age people abandon or reduce their social roles, activities, and interactions to find themselves again in old age. This disengagement is triggered by the prospect of impending death or diminished functioning capacities, among other factors. Disengagement is reciprocal between the individual and society, that is, the individual wishes to abandon certain roles and society takes them away. On the other hand, *the activity theory*[9] postulates that with age comes a period of growth and new opportunities. The more active the older person remains, the more satisfactory his or her aging will be and the more possibilities will open up that were previously unknown.

Decades later, Rowe and Kahn[10] proposed a scheme that aimed to combine both theories. They considered that gerontological research had focused solely on (bio)medical deterioration. However, it is useful to address some of these adversities by intervening in external, social factors, that go beyond (bio)medical treatment. In their first article, Rowe and Kahn emphasized that the decline of biological capacities is not necessarily inevitable: functional status may improve as one ages or biological capacities may remain intact. To this end, they make the following distinction to separate pathological changes associated with aging from those based on the notion of statistical normality. On the one hand, *usual aging* is comprehended as a health condition free of specific diseases, but accompanied by various age-related deteriorations and in which extrinsic factors increase the effects of the passage of time on the health of the living. On the other hand, *pathological aging* is understood as a health condition whose changes in the organism in parallel with age are similar to those induced by certain pathologies and is characterized by diverse and varied diseases or disabilities.

In this sense, Rowe and Kahn begin to glimpse the importance of the social dimension of aging.[11] Many approaches confuse usual aging with pathological aging and fail to realize that the heterogeneity of biological conditions depends, to a large extent, on social factors. In their second article, they articulate the model of successful aging in a complex manner.[12] This is defined as high physical, psychological, and social functioning in old age without serious diseases or limiting disabilities. The vast majority of age-related diseases can be prevented through healthy lifestyles. In addition, cognitive abilities, usually diminished with age, are highly dependent on the autonomy and independence possessed by older persons. Therefore, it should be understood that old age is a stage in which one can be engaged and committed to life: older people should continue to be productive and engage in meaningful activities that give sense and purpose to their existence.

Hence, successful aging occurs when older persons perform well on these three variables: absence or weakening of risk factors for developing diseases, autonomy and independence using their cognitive faculties, and a strong commitment to life. The novelty introduced by Rowe and Kahn is remarkable, as they connect bio (medical) indicators to the individual performance of older persons in a social context. Namely, biological decline depends to a large extent on whether these individuals continue to consider, both themselves and the society around them, that their lives have value and that they can continue to engage in activities independently and autonomously. Ageist conceptions place barriers to conceiving aging in this manner, as it is understood to be a life stage characterized by decline and decay.[13]

2.2 | The structural lag of social aging

Despite its importance and novelty, successful aging has received considerable criticism. This has been many and diverse,[14] but we will only focus on one of them: the lack of attention paid to the structural dimension of social aging.

Just after the publication of Rowe and Kahn's model, Riley[15] argued that successful aging was missing a fundamental aspect, that is, how the social variables of aging are rooted in structures that go beyond the aging person's conscious engagement and attachment to his or her own life. This idea was called the *structural lag*.[16] The success of the aging person cannot be understood solely on an individual basis, since how he or she conceives his or her own aging, the value of this vital stage, and the type of activities he or she can carry out depend on beliefs and institutions that go beyond the older person. In this sense, it is not enough to be a change in the personal attitudes toward old age and the families that accommodate them, but there must also be transformations in the social structures that make this attitudinal change possible. Without a general change in ageist conceptions, it will be much more difficult for the older adults to perceive themselves as helpful and having valuable lives. If valuable activities and specific spaces for the older adults are not developed, it will be challenging to ensure they reach a productive old age. If the pension system forces an early withdrawal from the world of work and this is what gives meaning to the individual's life, then it is likely that they will perceive that the most significant stages of their lives have already come to an end. Therefore, without the pertinent structural transformations, it is difficult for an individual change toward successful aging to take place.

[8]Cumming, E., & Henry, W. E. (1951). *Growing old: The process of disengagement*. Basic Books.
[9]Havighurst, R. J., & Albretch, J. (1953). *Older people*. Longmans.
[10]Rowe & Kahn (1987), op. cit. note 8.
[11]Ehni et al., op cit. note 4.
[12]Rowe & Kahn (1997), op. cit. note 8.
[13]Calasanti, T. (2016). Combating ageism: How successful is successful aging? *The Gerontologist*, *56*(6), 1093–1101; Langmann, E., & Weßel, M. (2023). Leaving no one behind: successful ageing at the intersection of ageism and ableism. *Philosophy, Ethics, and Humanities in Medicine*, *18*(1).
[14]Katz, S., & Calasanti, T. (2015). Critical perspectives on successful aging: Does it "appeal more than it illuminates"? *The Gerontologist*, *55*(1), 26–33; Martinson, M., & Berridge, C. (2015). Successful aging and its discontents: A systematic review of the social gerontology literature. *The Gerontologist*, *55*(1), 58–69.
[15]Riley, M. W. (1998). Letter to the editor. *The Gerontologist*, *38*(2), 151.
[16]Riley M. W., & Riley, J. W. (1994). Structural lag: Past and future. In M. W. Riley, R. L. Kahn & A. Foner (Eds.), *Age and structural lag* (pp. 15–36). Wiley.

Rowe and Kahn's model, therefore, does not take into account, according to Riley, either the institutional opportunities that influence successful aging or the extent to which the concept of aging is transformed by social changes. It is from this structural notion of social aging that we will conduct our analysis. We will analyze a phenomenon that is taking place in contemporary digital societies and that, with technological progress, may gain importance.

3 | THE PARADOX OF AGING IN THE DIGITAL ERA

In the previous two sections, we have reached two conclusions: first, social aging is a dimension largely neglected in the philosophical and scientific literature; second, the most relevant approaches to social aging have come from the theoretical framework of successful aging, which gives little weight to the structural character of the former. In this sense, the possibility of having an engaged old age through productive activities and autonomous behavior is only possible under a structure that allows this engagement to take place to a high degree.

In this part, we will develop the main argument of the article: addressing the structural nature of social aging today brings us to the *paradox of aging in the digital era*. This is, digital development and the increasing inaccessibility of its advances will make obsolete many biologically and chronologically young individuals; and, because the ability to work and be productive is the fundamental aspect of what we understand socially as aging, this will make us feel old at a very early age. A fairly typical case is Silicon Valley and the tendency of these companies to hire employees under 40 years of age.[17]

We will address this phenomenon as follows. First, we will expose the contemporary institutionalization of aging and how this is tied to a stage of life in which the individual is unproductive and stops working. Second, we will delve into the concept of obsolescence and show which typology best fits our analysis. Third, we will explore two central aspects of digitalization: (1) the acceleration of technological development and (2) the outdatedness of recently productively relevant skills. Finally, we will sketch a complete picture of the paradox of aging in the digital era.

3.1 | The institutionalization of aging around work

Life expectancy increased enormously throughout the 20th century. Advances in medical technology and the introduction of healthy lifestyles have been some of the causes of these changes.[18] This has made infant mortality and mortalities in other early stages of our lives to be seen as rare phenomena. We regard the death of a 30–40-year-old individual as a tragedy. A body at that age is still vigorous and allows to pursue life projects in good conditions in contrast to other periods. In this sense, death is currently understood as a phenomenon related to old age, even though it can take place at different stages of life.[19]

The proximity of death and the deterioration experienced at the biological level has led to conceive old age as a stage of decline and disengagement from habitual life practices. These disengagement approaches[20] turn old age into the twilight of our lives in which, in such biological conditions and in the face of the proximity of death, the only thing left to do is to reduce the suffering levels and make the transition as lighter as possible. However, these changes in mortality are not sufficient to explain why we comprehend aging in this manner. Our societies have undergone a series of political, economic, and institutional changes that have turned age into a fundamental organizing principle for the kinds of activities that are socially appropriate for different types of individuals.[21]

This process has been understood as *the institutionalization of the life course*.[22] The ways of life prior to economic modernization did not have age as an organizing principle of society: chronological age could be a criterion of status, but it did not occupy a central place in political and social considerations.[23] The economy was articulated around household units in which all their members, whether young or mature, contributed according to their functions and possibilities. However, the Fordist economy implied a change in the forms of work. The family ceased to be the primary economic unit and large companies with substantial productive apparatuses took its place. In this sense, educated and trained workers were required who could dedicate themselves, in a stable manner and for a good part of their lives, to wage-earning jobs.

On this basis, modern societies have become *temporized*, giving age a critical weight in the economic organization, but they have also become *chronologized*, that is, they have given force and normative content to different stages of life.[24] In order to have a body of workers suitable for modern economic imperatives, it is necessary that individuals first be educated to be well trained workers to perform their jobs subsequently. Once the aged body impedes the proper performance of productive activities, individuals must retire and enjoy a well-deserved leisure.[25] In this state, distinct chronological stages are distinguished in which different tasks and functions are assigned: childhood, in which the individual is trained and educated; maturity, in which work and production take place; and old age, in which leisure and rest are enjoyed.[26] What underlies all this is a

[17]Scheiber, N. (2014, March 23). The brutal ageism of tech. *The New Republic*. https://newrepublic.com/article/117088/silicons-valleys-brutal-ageism

[18]Oeppen, J., & Vaupel, J. W. (2002). Broken limits to life expectancy. *Science*, *296*(5570), 1029–1031.

[19]Baars, J. (2017). Aging: Learning to live a finite life. *The Gerontologist*, *57*(5), 969–976.

[20]Harriott, H. H. (2006). Old age, successful ageing and the problem of significance. *Ethical Perspectives*, *13*(1), 117–141.

[21]Baars, J. (2012). *Aging and the art of living*. JHU Press.

[22]Kohli, M., & Meyer, J. W. (1986). Social structure and social construction of life stages. *Human Development*, *29*(3), 145–149.

[23]Kohli, M. (2007). The institutionalization of the life course: Looking back to look ahead. *Research in Human Development*, *4*(3–4), 253–271.

[24]Kohli, op. cit. note 25.

[25]Riley et al., op cit. note 16.

[26]Baars, op cit. note 23.

pronounced *work ethics*.[27] Work[28] is the central pivot of contemporary societies, and chronological age is a proper means of organizing it.[29]

The intimate bond between aging and work at the societal level poses the following scenario: we understand that growing old is equivalent to ceasing to be suitable for work; therefore, if individuals cease to be suitable for work at a younger biological and chronological age, they may feel old at a younger age. Digital technologies can increase these processes of obsolescence. We shall examine first how the concept of obsolescence is intertwined with aging.

3.2 | Old age and obsolescence

We have analyzed in the previous subsection the rationale for the institutionalization of chronologically rigid life stages. The economic imperatives of work have led to a series of social norms that associate certain functions and activities with different parts of life. In this sense, there is a double bond: first, aging is socially determined according to the moment at which one ceases to be productive and, therefore, must abandon work; and, second, since age becomes a guiding organizational principle, societies have been chronologized, creating markedly differentiated life stages.

One of the most common criticisms of these entrenched ideas results from productive approaches to aging.[30] Rowe and Kahn[31] argue that an integral part of successful aging is to be productively engaged with life. Aging individuals must continue in some form or another to be productive in a meaningful sense, either by engaging in specific paid activities or volunteering for charitable projects. Moreover, the chronologization of old age in terms of unproductivity is often unjustified. In other words, an individual's chronological age is not the best indicator of his or her productivity. There are other intermediate variables that have greater influence.[32] Although some functional capabilities may be lost due to age, aspects such as experience or knowledge of the economic sector may still constitute comparative advantages over younger individuals.[33]

Nevertheless, while productive perspectives question the rigid chronologization of life stages, they do not focus on how the social concept of aging is rooted in productivity.[34] Their response is to make old age a productive stage, despite its biological conditions, and not to shed light on the social articulation of age around work. This means that older people who cannot be productive continue to be devalued for an unproductive old age. This lack of attention to social aging, in general, and the link between aging and work, in particular, has prevented the concept of *obsolescence* from emerging in philosophical debates on aging. Obsolescence is understood as the state in which an entity ceases to be produced or used because another entity is more productive than the former.[35] If old age depends on how productive that person is considered socially, we can understand that aged individuals have become obsolete for the performance of productive tasks compared to younger workers.

Overall[36] accounts for an astounding dimension of the concept of aging when we claim that the objects and artifacts around us have become "old." Often, we do not understand something to be old because of the amount of chronological time it has spent at our side or due to its physical deterioration, but because, even if we have recently acquired such artifact, it has already become outdated with respect to newer ones. However, aging consists primarily of a deterioration of the capabilities that allow the individual to be productive and not so much in a progress that makes older people outdated. Can we really understand the unproductiveness of aging as obsolescence? There are several ways of understanding obsolescence. Danaher[37] proposes the following classification, which we have arranged in Table 1.

In this sense, we usually associate obsolescence related to aging with the loss of the biological capacities necessary to be productive and the inability of the entity to adapt to this decline.

On the contrary, the phenomenon we want to analyze is not based on this intuitive notion of the obsolescence of older people. What we want to defend is that digital technologies are producing a type of obsolescence in which the unproductiveness of aging no longer depends solely on the decline of biological capacities (1) but that changes in the purposes and expectations of digital societies (2) are occurring at such a speed (ii and iii) that individuals are increasingly having trouble adapting to new technologies and the productivity associated with them (i). Namely, in digital societies we are in danger of being perceived personally and socially as old despite being chronologically and biologically young. However, to understand this phenomenon properly, we must first justify the extent to which this obsolescence can take place in digital societies.

[27]Frayne, D. (2015). *The refusal of work: The theory and practice of resistance to work*. Bloomsbury Publishing; Weeks, K. (2011). *The problem with work: Feminism, marxism, antiwork politics, and postwork imaginaries*. Duke University Press.

[28]The concept of work is not univocal. While it has been used both to capture all physical or mental effort made by one or more individuals and to express the performance of meaningful activities, we restrict our notion to paid work. For a discussion of the varieties of this concept and why paid work should be advocated in these debates, see Danaher, J. (2019). *Automation and Utopia: Human flourishing in a world without work*. Harvard University Press. We thank an anonymous reviewer for suggesting us to make this clarification.

[29]Kohli, M., Rosenow, J., & Wolf, J. (1983). The social construction of ageing through work: Economic structure and life-world. *Ageing & Society*, *3*(1), 23–42.

[30]Morrow-Howell, N., & Greenfield, E. A. (2016). Productive engagement in later life. In K. George & K. F. Ferraro, *Handbook of aging and the social sciences* (8th ed., pp. 293–313). Elsevier.

[31]Rowe & Kahn (1997), op. cit. note 8.

[32]Ibid.

[33]Morrow-Howell & Greenfield, op. cit. note 33.

[34]Baars, op. cit. note 20.

[35]Sparrow, R. (2019). Yesterday's child: How gene editing for enhancement will produce obsolescence—and why it matters. *The American Journal of Bioethics*, *19*(7), 6–15.

[36]Overall, C. (2016). How old is old? Changing conceptions of old age. In G. Scarre, *The Palgrave handbook of the philosophy of aging* (pp. 13–30). Palgrave Macmillan.

[37]Danaher, J. (2022). Technological change and human obsolescence: An axiological analysis. *Techné: Research in Philosophy and Technology*, *26*(1), 31–56.

TABLE 1 Types of obsolescence and causal variables.

How to understand obsolescence?	What variables contribute to causing obsolescence?
1. Decline of the entity's internal capabilities.	i. Pace of change
2. Changes in social expectations and goals	ii. Adaptability of the entity
3. Improvement of the capabilities of other entities against whom the entity competes.	iii. Adaptability of the society in which the entity is embedded.

3.3 | Obsolescence in digital societies

The effects of digitalization on the older adults can be ambiguously understood.[38] Digitalization can bring with it many benefits for the older adults: first, it gives them means to combat isolation; second, it can improve their capabilities by giving them more and better access to sources of information; third, it facilitates the monitoring of the status of their pathologies and medical conditions; and, fourth, it improves assistive technologies for disability.[39] Nonetheless, digitalization can also entail many risks, mainly those arising from the digital divide. Broadly speaking, the digital divide is defined as unequal access to and use of digital technologies by different social groups. The older adults are particularly affected by this divide, as they tend to be more disengaged from digital technologies than other groups. Nevertheless, it should be noted that the degree to which older adults are affected by the digital divide is diverse. It should not be understood as a monolithic phenomenon: digital exclusion depends on the type of technology[40] and the life experience of the older person.[41]

Van Dijk and Hacker[42] conceptualize the digital divide in a complex, dynamic, and multidimensional manner. Disadvantaged social groups are affected in different and changing ways over time. They identify four types of digital divides: (a) the psychological divide, that is, lack of digital experience; (b) the material divide, that is, difficulty in accessing digital media; (c) lack of capabilities and skills to use digital resources; and (d) lack of opportunities to use these technologies. Older people are affected in all these dimensions. They lack digital experience, since digital technologies appeared in their adult stage and they are barely familiar with them. All this means that they have hardly developed digital skills or normalized spaces for their use.[43]

However, while there is growing concern about the digital divide affecting the biologically and chronologically aged, we believe that little attention has been paid to its effects on the concept of aging. Some empirical evidence has reported the negative effects of the social contexts of implementation of digital technologies on the self-perception of aging.[44] Though no systematic research has been done on changes in subjective aging in biologically and chronologically young individuals, some studies have shown how new digital technologies aggravate subjective aging in older adults.[45] The phenomenon we will describe below is, in our view, being overlooked.[46] If contemporary understandings of social aging are linked to obsolescence and unproductivity and create distinct life stages, then it is possible that digitalization may widen the chronological age considered as old if chronologically and biologically young individuals cease to be productive. The thesis we defend is that the digital divide will make chronologically and biologically young people obsolete and, since social aging is linked to the ability to be productive and work, we will be perceived personally and socially as old at a younger age.

Moreover, we have not yet shown why digitalization produces human obsolescence and what typologies are involved. We believe this is so for the following reasons, which involve two variables and two types of obsolescence: the technological acceleration that accompanies digitalization (i) leads to rapid modification and complexification of the socially necessary capabilities for productive work (2); the speed and complexity of these changes make it difficult for chronologically and biologically young humans to adapt (ii); and the digital society is unable to reengage these individuals in productively meaningful ways (3).

First, the pace of technological development seems to be much faster than in other historical periods.[47] This is mainly due to the shortening of technological change cycles.[48] Digital technologies

[38]Francis, J., Ball, C., Kadylak, T., & Cotten, S. R. (2019). Aging in the digital age: Conceptualizing technology adoption and digital inequalities. In B. Barbosa Neves & F. Vetere, *Ageing and digital technology: Designing and evaluating emerging technologies for older adults* (pp. 35–49). Springer.

[39]Cutler, S. J. (2006). Technological change and aging. In R. H. Binstock & L. K. George, *Handbook of aging and the social sciences* (6th ed., pp. 257-276). Elsevier.

[40]Van Boekel, L. C., Peek, S. T., & Luijkx, K. G. (2017). Diversity in older adults' use of the internet: Identifying subgroups through latent class analysis. *Journal of Medical Internet Research*, *19*(5), e180.

[41]McCosker, A., Critchley, C., Walshe, J., Tucker, J., & Suchowerska, R. (2021). Accounting for diversity in older adults' digital inclusion and literacy: the impact of a national intervention. *Ageing & Society*, First View, 1–21.

[42]Van Dijk, J., & Hacker, K. (2003). The digital divide as a complex and dynamic phenomenon. *The Information Society*, *19*(4), 315–326.

[43]Francis et al., op. cit. note 34.

[44]Köttl, H., Gallistl, V., Rohner, R., & Ayalon, L. (2021). "But at the age of 85? Forget it!": Internalized ageism, a barrier to technology use. *Journal of Aging Studies*, *59*, 100971.

[45]Caspi, A., Daniel, M., & Kavé, G. (2019). Technology makes older adults feel older. *Aging & Mental Health*, *23*(8), 1025–1030.

[46]Some authors have taken this direction. For a discussion of the effects of the socio-material context on geroscience and ways of approaching its conceptualization, see Peine, A. & Neven, L. (2019). From intervention to co-constitution: new directions in theorizing about aging and technology. *The Gerontologist*, *59*(1), 15–21. We are grateful to an anonymous reviewer for encouraging us to highlight this literature.

[47]Korunka, C. (2022). Working with digital technologies: Complexity, acceleration, and paradoxical effects. In H. Schaffers, M. Vartiainen & J. Bus, *Digital innovation and the future of work* (pp. 137-155). River Publishers; Kurzweil, K. (2005). *The singularity is near: When humans transcend biology*. Viking; Sparrow, op. cit. note 38.

[48]Nadkarni, S., & Prügl, R. (2021). Digital transformation: A review, synthesis and opportunities for future research. *Management Review Quarterly*, *71*, 233–341.

seem much more disruptive than past technologies. The great technological revolutions required a period of gradual evolution and refinement of the available technologies before significant disruptions took place. In contrast, new digital technologies require material, organizational, and workforce capability changes every short period of time.[49]

Second, updating the skills needed (c) to perform productive work with digital technologies is made difficult by the speed of these changes and the increasing complexity of these technologies.[50] Humans need time to adapt to the changes and it may be difficult for them to readapt after the effort invested in specializations.[51] Moreover, digital technologies tend to be more complex for two reasons: individually, because the knowledge needed to use and understand digital devices is very specialized; at the level of the socio-technical system, the technologies are strongly interrelated and a thorough knowledge of the technological context is needed.

Third, the limitations of human beings to adapt quickly and continuously to new digital technologies could mean that, given that the capabilities acquired during the formative stage may become obsolete, individuals who have developed these capabilities will be outdated. Two problems would arise from this: on the one hand, obsolete individuals would lag behind the next generation, which would have acquired the momentarily required digital skills[52]; on the other hand, AI technologies could perform these tasks autonomously, more efficiently, and could be more adaptable.[53] Finally, if economic development is intimately linked to the advancement of digital technology, then it seems difficult to build economically secure spaces for these individuals to continue to be considered productive.[54]

In this sense, obsolescence processes derived from digital technologies can take two paths: substitution and inadaptation. The first lies in the substitution of a certain human labor by a technology. Care robots[55] or medical-type algorithms[56] could lead to better results than human work. In this sense, the individual would have become obsolete with respect to the activity for which he or she would have specialized. The second is that the evolution and complexity of certain skills or knowledge would make certain technologies more adaptable. This involves software tools that change abruptly every short period of time and complex smart technology systems that function better in a self-regulating manner.[57]

3.4 | Unraveling the paradox of aging in the digital era

Our proposal has many similarities with Baars' paradox of the young old.[58] This is, given the rigidity of life stages and their temporization, we find individuals at very different stages of biological aging, but belonging to the same chronological life stage. The increasing improvement of biological conditions during the aging process in the last century leads us to believe that individuals in perfect biological conditions, but who reach a certain chronological age, are old. This is accentuated by the new economic dynamics. Chronologically younger individuals, whose age is in their 40s or 50s, have been categorized as "old workers."[59]

However, we find that Baars did not take to its ultimate consequences the intuition that we are getting older at a younger age. This is due to the limited role played by the concept of obsolescence in his analysis. Our argument has connected three parts: first, the stages of life have been institutionalized with the emergence of modern forms of work and the shift from a household economy to a capitalist economy of wage labor; second, three stages of life have developed according to their relation to productivity, which means that old age is conceived as the time when the individual becomes obsolete for work; and, third, obsolescence does not only occur through a decline in the biological capacity to work but can also occur through an increase in the demands on the capacities needed to be productive: this is what happens in digital societies. In this sense, very young individuals, who have not exceeded the decade of 20–30 years, may be perceived personally and socially as old since their productive capacities have become completely outdated.

The accelerated and complex technological changes resulting from digitalization, if aging is socially understood as an obsolete stage of life, can lead to a very significant widening of our social old age, even though we may be biologically and chronologically young. Just as Baars claimed that the chronologization of old age and the increase in life expectancy had led to the paradoxical result of young individuals being considered old, we point out that, even in optimal biological conditions and in very early chronological stages, we can feel old much earlier. This happens in some work environments, where at a very early chronological age it is conceived that the person loses the dynamism, flexibility, and braveness to face the changes of social reality continuously.[60] Our skills become obsolete: despite maintaining them and continuing to perform the jobs we did before in good conditions, they become totally outdated in the light of the new productively necessary skills.[61]

[49]Ibid.
[50]Chauhan, S. P., & Chauhan, D. (2008). Human obsolescence: A wake–up call to avert a crisis. *Global Business Review*, *9*(1), 85–100.
[51]Sparrow, op. cit. note 38; Wolbring, G. (2010). Obsolescence and body technologies. *Dilemata*, *2*(4), 67–83.
[52]Sparrow, op. cit. note 38.
[53]Agar, N. (2019). *How to be human in the digital economy*. MIT Press.
[54]Danaher, op. cit. note 26.
[55]Sparrow, R. (2016). Robots in aged care: A dystopian future? *AI & Society*, *31*, 445–454.
[56]Ferrario, A., Gloeckler, S., & Biller-Andorno, N. (2023). Ethics of the algorithmic prediction of goal of care preferences: From theory to practice. *Journal of Medical Ethics*, *49*(3), 165–174.
[57]Danaher, op. cit. note 26.
[58]Baars, op. cit. note 23.
[59]Guillemard, A.-M., & Argoud, D. (2004). France: A country with a deep early exit culture. In T. Maltby, B. De Vroom & E. Øverbye (Eds.) *Ageing and the transition to retirement: A comparative analysis of European welfare states* (pp. 165–185). Ashgate.
[60]Scheiber, op. cit. note 18.
[61]Sparrow, op. cit. note 38.

4 | CONCLUSION

In this article, we have argued that, if the structural dimension of social aging is taken into consideration, a distinctive phenomenon that contemporary societies are starting to witness can be theoretically delimited: the paradox of aging in the digital era. Since life stages are rigidly institutionalized and endowed with normative content based on the concepts of productivity and obsolescence, the technological acceleration of digitalization processes will make cohorts of chronologically and biologically young individuals obsolete. They are, therefore, likely to be considered, both themselves and socially, old.

The argument has been developed as follows. First, it has been shown that, despite the apparent lack of consensus in geroscience, many lines of research are based on the concepts of biological and chronological aging. This means that very little attention has been paid to the social dimension of aging. Second, Rowe and Kahn's successful aging has been presented as the best-known model when it comes to exposing the relevance of social aging. They argue that successful aging can only occur if the older person is socially engaged. In contrast, Riley has argued that Rowe and Kahn miss a fundamental aspect of social aging: the structural lag. In order to be socially engaged, a number of structural conditions are needed.

Third, we departed from the notion of social aging in its structural sense to analyze the paradox of aging in the digital era. It has been argued that old age has been socially defined as an unproductive stage in which one no longer possesses the biological capacity to work. This makes the concepts of aging and obsolescence intimately intertwined at the societal level. Subsequently, it has been stated that digitalization accelerates the processes of obsolescence by making previously productive human capabilities rapidly outdated. Thus, if old age acquires its social meaning through obsolescence and, with digitalization, we run the risk of cohorts of biologically and chronologically young individuals becoming obsolete, it is likely that the chronological stage of old age will be extended.

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ORCID

Joan Llorca Albareda http://orcid.org/0000-0003-4889-3859

AUTHOR BIOGRAPHIES

Joan Llorca Albareda is a PhD candidate and research assistant at the Department of Philosophy I in the University of Granada. He graduated in Philosophy, Politics, and Economics (PPE) in 2019 from Pompeu Fabra University of Barcelona, Autonomous University of Madrid, and Carlos III University of Madrid. He also obtained a master's degree in political theory and a master's degree in applied ethics, both from Complutense University of Madrid. His main lines of research have covered various fields of applied ethics, including technology ethics and bioethics. He is now currently delving into the ethical and social challenges surrounding aging and the moral status of artificial intelligence entities. His work has been published in prestigious journals of these research fields such as *Philosophy & Technology* and *Journal of Medical Ethics*.

Pablo García-Barranquero is a philosopher of medicine, with a special interest in analyzing the process of human aging and the conceptual and normative implications of its (possible) pathologization. He is currently assistant professor in the Department of Philosophy at the University of Malaga, Logic and Philosophy of Science. Before joining Malaga, he was a postdoctoral researcher in the Department of Philosophy at the University of Granada, working in a group concerned with the impact of technology on human beings. He was also a postdoctoral researcher at the Research Unit of Philosophy of Science and Human Development at Universitá Campus Biomedico di Roma, working on a project on whether the rejuvenation concept is scientifically and philosophically coherent and plausible. He has also been a visiting researcher, among other places, at the School of History, Philosophy, Political Science and International Relations at Victoria University of Wellington, or the Social Medicine Department at UNC.

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