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Keep learning: advantages of age in science. Success and failure are inevitable in any research career, but what truly makes it fascinating is the boundless opportunities for learning. However, ageism in academia is just as relevant as in any other field. Misconceptions about scientific productivity and the strong competition for resources often lead to age discrimination. While physical impairment can occur with age, it does not necessarily lead to cognitive impairment. In fact, evidence suggests that some functions improve with age in healthy individuals. By excluding older individuals from professions that do not require physical labour, as is the case in research, society misses out on the benefits of their knowledge and experience. This impacts the advancement of knowledge, social cohesion, and justice. This paper takes an integrative perspective on the implications of aging in a research environment and provides examples of policies that favour age inclusion in academia.
KEYWORDS: ageism, academia, research, inclusiveness, forced retirement with age.

Continuemos a aprender: vantagens da idade na ciência. O sucesso e o fracasso são inevitáveis em qualquer carreira de investigação, mas o que a torna verdadeiramente fascinante são as oportunidades ilimitadas de aprendizagem. No entanto, o idadismo no meio académico é tão relevante como em qualquer outro domínio. As conceções erróneas sobre a produtividade científica e a forte concorrência pelos recursos conduzem frequentemente à discriminação em função da idade. Embora a deterioração física possa ocorrer com a idade, não conduz necessariamente a um declínio cognitivo. De facto, há provas que sugerem que algumas funções melhoram com a idade em indivíduos saudáveis. Ao excluir os idosos de profissões que não exigem trabalho físico, como é o caso da investigação, a sociedade perde os benefícios dos seus conhecimentos e experiência. Este facto tem impacto no avanço do conhecimento, na coesão social e na justiça. Este artigo adota uma perspetiva integradora sobre as implicações do envelhecimento num ambiente de investigação e fornece exemplos de políticas que promovem um meio académico mais inclusivo.
PALAVRAS-CHAVE: idadismo, meio académico, investigação, inclusão, reforma compulsiva com a idade.

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MÁRIO BARBOSA

Keep learning: advantages of age in science

DEMOGRAPHIC CHANGES AND THEIR IMPLICATIONS IN ACADEMIA[1]

The percentage of elderly people is on the rise worldwide. For instance, in 2022, more than one-fifth (21.1%) of the EU population was aged 65 and over, and half of its population was older than 44.4 years (UN, 2024). In the same publication, it is forecasted that by 2100, the age pyramid will take on more of a block shape due to the continuous aging of the EU population. Additionally, the percentage of the population over 65 will increase from 21.1% in 2022 to 31.3% by 2100, and the percentage of those aged 80 or above is projected to increase from 6.1% to 14.6% over the same period.

These demographic changes will have implications across all areas of society, including academia. This will challenge universities to respond to the demands of an aging population, including among their faculty, namely by recognizing that ageism permeates academic institutions as it does in other areas (Cronin and Brooke, 2019). By 2100, many researchers who are now young will be in the over-65 age group and will live in a society in which one in every three citizens will be considered old, according to present demographic standards. They will then say what many citizens say now: "I'm aged, but I don't feel old." This reflects our perception of time and how longevity has changed it. Although we start aging when we are born, our perspective on what is aging changes with life, depending on the position we occupy on the time scale. In fact, it has long been recognised that time perspective emerges from the cognitive human experience of partitioning time into past, present,

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and future, which in turn influences much of human behaviour (Zimbardo and Boyd, 1999). For instance, when we are thirty years old, we see someone in their forties as old, and when we are forty years old, we see people in their thirties as young. This perception of time and age will have to be translated into the new context in which universities will have to operate, namely by breaking down age-segregation and engaging in intergenerational solidarity in line with social-psychological principles known to reduce prejudice and discrimination (Cronin and Brooke, 2019).

FORCED RETIREMENT BASED ON AGE AS A FACET OF AGEISM

Ageism is a relevant social phenomenon that has been addressed in multiple studies. In a report on ageism, the World Health Organization (WHO) considers that "Both older and younger adults are often disadvantaged in the workplace, and access to specialized training and education declines significantly with age" (WHO, 2021). Phrases like "You are too young" or "you are too old" are two faces of the same discriminatory attitude. If people are set aside simply as a result of age labelling, the discrimination is as unfair as sex or citizenship discrimination. Many elderly citizens remain active until a late age, competing with younger individuals for jobs. This competition and the maintenance of stereotypes associated with the elderly, ranging from mental to sexual capabilities, have originated several forms of discrimination based on age. However, the discussion on age discrimination is often muted. Twenty years ago, Newman (2001) stated that, "The debate may have been far more muted than over sex and race discrimination not so much because there is a consensus, but rather because all individuals can expect to someday enter the class of individuals protected by age discrimination laws, so that the issues of fairness are perhaps less prominent." Twenty years later, the following was written by the Assistant Secretary-General for Policy Coordination and Inter-Agency Affairs in the Department of Economic and Social Affairs of the USA: "Ageism towards younger and older people is prevalent, unrecognized, unchallenged, and has far-reaching consequences for our economies and societies" (UN, 2021). It's worth emphasizing that the US Congress approved the Age Discrimination in Employment Act in 1967, showing that legislation by itself has not been an effective tool against ageism.

In some countries, legislation actually promotes discrimination based on age. For instance, in Portugal, a decree that establishes that Civil servants are forced to retire at 70 years of age is still in force, despite being almost 100 years old (Decree 16563 of March 1929). Academia is not immune to this form of discrimination. In many countries, forced retirement at a fixed age

is mandatory in academia. This abrupt retirement process changes a person's life in less than 24 hours. One day a person goes to bed with full responsibilities as an academic, and the next day she/he wakes up with none. In the UK, the Equality Act 2010 provides that age-based policies are only lawful if the treatment can be "objectively justified" as proportionate to achieving a legitimate aim or if it is contemplated by a specific exception. However, under the same act, the Employment Tribunal (ET) made distinct decisions in judgments that involved the University of Oxford and two of its professors. In one case, the ET ruled in favour of the university, while in the other, it ruled in favour of one of the professors (Paul Ewart, Professor in Physics). Stuart Goosey, a Lecturer in Law at the University of Leeds, made a legal analysis of both cases (Goosey, 2020) and considered that, although a mandatory age policy might increase the opportunities for employment of women and ethnic minorities, it cannot justify the detrimental impact of the policy on older academics. According to Goosey, the policy ought to be considered unjustified and unlawful. Clearly, legislation, by itself, is not sufficient to change the cultural background of ageism, as exemplified by the fact that the Age Discrimination in Employment Act approved in 1967 did not change much in the USA, as indicated above. Clearly, a change in cultural attitudes is required to fight ageism.

Society has evolved a great deal in many aspects. However, some concepts inherited from the past remain deeply rooted in our way of thinking and behaving. Several forms of discrimination have not been eradicated from societies, namely based on gender, religion, sexual orientation, and age. There have been numerous scientific publications, reports, and public positions addressing the issue of ageism in society. For instance, Maria J. V. Rosa, a social sciences researcher, has written (Rosa, 2020) that "Forced retirement is determined by the chronological age and is independent of skills or work outputs." According to a publication of the Eurobarometer Survey on Active Aging, published in 2012 (Social, 2012), almost two-thirds of Europeans believed they should be allowed to continue working beyond the official retirement age. Also, two-thirds of Europeans considered that combining part-time work and a partial pension is more appealing than full retirement. In a more recent Eurobarometer report (*Special Eurobarometer 493*, 2019), 40% of Europeans consider that being perceived as either too young or too old is a reason for discrimination in their country. In France, Portugal, the United Kingdom, and Greece, more than 50% of respondents think that this discrimination is widespread. The countries in which this notion is less widespread (represented by *ca*. 20% of the responders) are Germany, Slovakia, and Luxembourg. In spite of this, about 90% of the respondents say that they would feel comfortable if they had a younger person

as a work colleague, the percentage being almost the same when the question was about having an older person as a work colleague. Of significance was the fact that respondents who completed their education at 20 years of age or older had a greater acceptance of working with younger or older persons than those who completed their education at a younger age.

Ageism may also have implications in lifespan and quality of life. For instance, the risk of early death after compulsory retirement increases, mainly due to changes in lifestyle, as found in a study in Japan (Sakurai et al., 2020). Although the concept of active aging involves three pillars – employment, social participation, and independent living – involuntary early retirement chops off the first pillar and brings with it important consequences in individual well-being, with most retirees in Europe having liked to work longer (Ebbinghaus and Radl, 2015).

DECONSTRUCTION OF THE GENERALISED AGE IMPAIRMENT CONCEPT

Ageing is a progressive process that does not follow the same path for every individual, being characterised by a high degree of variability. Biologically, it affects organs and functions in different manners and at different times and that can be associated with specific hallmarks (e.g., genomic instability, telomere attrition, epigenetic alterations, loss of proteostasis, deregulated nutrient sensing, mitochondrial dysfunction, cellular senescence, stem cell exhaustion, and altered intercellular communication) (Lopez-Otin et al., 2013). Although ageing increases the incidence of some diseases, namely cancer, cardiovascular, osteoarticular, and neurological diseases, there is no established or standardised definition of aging-related disease (Le Couteur and Thillainadesan, 2022). Some diseases reach peak incidence at about 50-70 years, then plateau or decrease substantially at older ages (Le Couteur and Thillainadesan, 2022). The decline in physical and cognitive functions is determined by biological, environmental, cultural, and social determinants that vary greatly from individual to individual and have evolved over the years. For instance, depending on the type of activity, older and younger subjects present differences in the normative scripts of everyday activities (Smith, Newberry and Bailey, 2020), with an advantage of older adults for what the authors consider "older adult activities." Furthermore, based on the observation that we encode and comprehend an event based on its segmentation into discrete events, the authors found that older adults presented an advantage over younger adults in recognizing the boundaries between events. Furthermore, their recognition memory was better for the older adult activities. Previous works have shown that

knowledge structures remain intact, and many may even improve with age, such as verbal knowledge (Park et al., 2002).

Our life expectancy has increased significantly since 1960. In 2015, life expectancy at birth had increased by 19.4 years, 9.9 years at the age of 20, and 4.4 at the age of 65 (Aksan and Chakraborty, 2023). In 2017, the life expectancy at birth in the world was about 73 years, according to a report of the WHO (IHME, 2018). However, according to the same report, 10 of these years are marked by poor quality of life. The question we face as a society is how to decrease this 10-year poor health gap. Many people would like to live longer, but do they want to have long lives with poor quality of life? Certainly not. The causes for the number of years lived with disability significantly change with age (Diseases and Injuries, 2020). According to this report, when we are young, road injuries, headache disorders, self-harm, and depressive disorders come high on the list. The same report shows that in 30 years (1990 to 2019), depressive disorders have increased, as well as low back pain. Above 75 years of age, ischemic heart diseases, stroke, chronic obstructive pulmonary diseases, and Alzheimer's disease become major factors in the number of years lived with disability.

Reducing the burden of disease will rely not only on medical care but also on other less costly strategies. Some of them may take advantage of the benefits of socialization in the health condition of citizens, both young and old. It is relevant to note that even animal experimentation supports the notion that socialization between younger and older subjects increases healthy longevity. In a paper published by Diaz-del Cerro et al. (2022), it has been demonstrated that short periods of interaction between older and younger rats improved the behavioural capacity, immunity, and oxi-inflammatory state of the former, extending their healthy lifespan.

Rendering societies more age-inclusive will imply that differences brought by age should be taken into consideration in the activities performed by different age groups. Society does not expect a soccer player, who was brilliant in her/his 20s and 30s, to maintain the same level of performance at the age of 50 or 60. However, if he/she remains in the same activity as a soccer coach, this is regarded as natural. Similarly, politicians in democratic systems are subjected to scrutiny by fellow citizens and may be re-elected if voters consider her/him fit for the job. A large majority (*ca*. 75%) of Europeans feel comfortable with the idea of a person perceived as old or young being elected for the highest political position in their countries (*Special Eurobarometer 493*, 2019). In essence, none of the above activities has an upper age limit because soccer players and politicians are judged by their merit according to the rules of the game they are playing. The question is whether physical impairment that

affects some professionals goes hand in hand with cognitive impairment. The evidence is that cognitive functions may improve with age, as shown below.

BIOLOGICAL AND ACADEMIC AGES AND SCIENTIFIC PRODUCTIVITY

When the three demographic age groups (0-14, 15-64, and over 65) were established, the middle age group was identified as the working or productive period. However, the extension of training until adulthood in more advanced societies has led to a shortening of the conventional working period. In these societies, working fewer years did not result in a loss of productivity. On the contrary, it has been amply shown that education has a positive effect on productivity and leads to improvements in technology efficiency (Moretti, 2004; Fleisher et al., 2011). Similarly, productivity is not directly related to longer working hours. In fact, some studies show that productivity decreases with longer working hours (Collewet and Sauermann, 2017; Delmez and Vandenberghe, 2018), with fatigue possibly playing a major role (Collewet and Sauermann, 2017). However, firms prefer a higher level of hours to cover quasi-fixed costs (i.e., costs associated with employing a worker that are independent of his/her hours of work), even if that is associated with a decline in productivity (Delmez and Vandenberghe, 2018).

With the acknowledgment of the importance of education and the prolongation of schooling, people now enter the labour market when they are in their twenties or even thirties. The implication is that their working period is drastically reduced. Therefore, the 15-64 age group is actually composed of a training period and a working period. Extending the training period but not altering the retirement age impacts on the actual number of working years. This is particularly relevant for professions that require a long period of training, including medical doctors and researchers. Typically, researchers in European institutions defend their PhD at the age of 30, thus having a prospective career span of 35 years. However, as pointed out by Kwiek and Roszka (2022), one must distinguish biological age from academic age, the latter being the time measured after the first publication. The authors suggest that in scientifically developing countries, the usage of academic age as a proxy for biological age must be employed with more caution than in advanced countries. Furthermore, they stress that the discrepancy between the two ages is more pronounced in social and human sciences. The implication is that researchers from these areas working in developing countries would be at a greater scientific disadvantage than those from developed countries if the retirement age is determined solely by biological age.

Researchers age like anybody else. Does this imply that there is a positive correlation between age and scientific productivity? Not really. Way et al. (2017) state that "the canonical narrative of 'rapid rise, gradual decline' describes only about one-fifth of individual faculty, and the remaining four-fifths exhibit a rich diversity of productivity patterns." Some researchers reach the peak of their productivity after 35 or even 40 years of their career. The age distribution of the USA National Institute of Health (NIH) Principal investigators shows that the majority of PI are in the 50-55-year range (Orwoll, 2016). The number of PI declines after that, but some remain scientifically active until their 80s.

TOWARDS AN AGE INCLUSIVE ACADEMIA

The introduction of business-oriented models for managing universities has resulted in a decline in permanent academic positions, which has become a widespread trend (Acker and Haque, 2017). With the investment in PhD training, the ratio between new PhD holders and new academic positions has dramatically increased in many countries, as illustrated by a surplus of 6.3 PhD graduates for every biomedical tenure track position in the United States (Ghaffarzadegan et al., 2015). The Nature's 2019 PhD survey indicates that 56% of PhD students around the world continue to aspire to careers in academia despite a global job crunch (Woolston, 2019). The same publication reveals that a staggering percentage (36%) of PhD students sought help for anxiety or depression caused by PhD studies.

Furthermore, what was paradigmatic in the traditional route for tenure is no longer valid in the new models of entrepreneurial universities, whose mission includes fostering innovation, industry partnerships, and economic development. The gradual shift from focus on advancement of knowledge to innovation has been marked by the need for researchers to become entrepreneurial and secure their own employment, which is often attached to external research grants. The concept of a "job for life" is no longer valid for a vast majority of academic researchers. Securing a permanent position is becoming increasingly difficult in academia and impacts many decisions of early career researchers, including the decision of women to conceive their first child (Hughes, 2021). Furthermore, academics globally have been confronted with workload challenges during the last two decades, making them feel that in higher education they need to fulfil three full-time jobs—research, teaching, and leadership (Khan and Siriwardhane, 2021). In this context, women are at a disadvantage with respect to men since progression to higher levels is strongly impacted by excessive workloads, which negatively influence research

activity (Barrett and Barrett, 2011). The traditional career ladder, in which one knew the steps to be climbed, is no longer applicable for the vast majority of researchers, since peer rivalry is commonly pointed out as a barrier to career progression (Santos, 2016). Older academics in more advanced career stages view career blockages and peer rivalry as more important career barriers than their younger colleagues (Santos, 2016).

The above findings support the widespread notion that barriers exist from the entry stage and persist throughout the academic career. Although universities have introduced criteria for the assessment of candidates for an academic position and for career progression, there is an overall lack of understanding of what is required at each stage of an academic career (Kindsiko and Baruch, 2019). Data extracted from a European job platform gathering data from 40 different disciplines, 3000 universities, and 60 countries indicate that mobility is key to progression in senior roles and that teaching gains importance toward professoriate (Mantai and Marrone, 2023). However, it has been advocated that new methods of assessment are required, combining qualitative and quantitative parameters, including community life, culture of integrity, transmission of knowledge, apart from publications (Bommier, 2022). In the absence of generally adopted and transparent methodologies, the likelihood of ambiguity and discrimination increases.

In an attempt to avoid discrimination, academic institutions have resorted to metrics, with the argument that metrics are more objective than qualitative appraisal. However, metrics are particularly unfair for early career researchers, since they fail to adequately assess real-world factors such as leadership, mentorship, impact on societal stakeholders, or science citizenship/service (Fisher and James, 2022). The failure of academia to find a fair system of removing unproductive researchers from the career ladder and providing permanent positions for early career researchers has led to the argument that imposing an age limit for retirement or encouraging early retirement makes more room for contracts with younger professors and researchers. However, this argument is not sustainable in the long run. As Feichtinger, Grass and Winkler-Dworak (2020) put it, "The purpose of the early retirement programs was to rejuvenate the faculty by opening positions for young academics once the older faculty staff retires. Such a policy might be tempting in times of an aging faculty, particularly if many of the staff are close to retirement. If the then-vacant positions will be immediately filled with young promising academics, the mean age of the faculty will drop substantially as many young scholars will replace their older colleagues. However, the effect will only be temporary." The authors argue that a mix of young and old entrants would guarantee a young academy while avoiding a freeze of recruitment altogether. The elimination of

mandatory retirement in USA universities did not contribute to the rejuvenation of American universities, since the retirement rates of 70- and 71-year-olds were comparable to rates of 69-year-olds (Ashenfelter and Card, 2002). Mandatory retirement validates and perpetuate age discrimination policies that are pervasive in universities (Cronin and Brooke, 2019), thus rendering the institutions less age inclusive. The examples presented above regarding forced retirement of two University of Oxford professors illustrate the controversy of the subject even from the legal point of view. Also, in the USA, a proposal from the National Institutes of Health (NIH) to create an Emeritus Grant initiative aimed at funding older investigators met fierce opposition (Kahana et al., 2018). The authors raise concern about punitive actions toward older colleagues and question the value of higher education in counteracting prejudice toward older people. Ethically, forced retirement is demeaning of the dignity of work, since working is relevant to central human capacities, such as being healthy, having bodily integrity, choosing a plan of life, and affiliating with others (Jecker, 2023). Measures to counteract prejudice include intergenerational dialogue (Fletcher, 2007), mentorship initiatives provided by senior scholars to their younger colleagues (Kahana et al., 2018), and funding mechanisms that encourage older scientists to devote substantial time toward developing younger investigators' careers (DeLisi, 2019). This would enable younger researchers to benefit from the knowledge, experience, and wisdom of elder peers and contribute to a more inclusive university, with spill-over effects to other areas of society. Leading by example is an effective manner of passing on values to others.

Retirement models in universities are evolving, and there is a need to reinvent academic retirement (Baldwin, Belin and Say, 2018). Gradual retirement would provide a healthy turnover in universities if the outflow of retiring professors is balanced by the inflow of younger members. Gradual retirement policies enable a person to plan their retirement decisions, enhancing well-being in later life and facilitating people's commitment (De Vaus et al., 2007). Planning retirement is a personal as well as an institutional responsibility. At the University of Southern California (USC), phased retirement is part of a contract that stipulates the retiring period and the workload for each of the phased retirement years. USC has also established a USC Emeriti Centre, an USC Emeriti College, a Retired Faculty Association, and a Staff Retirement Association (Brown and Jones, 2018). A survey carried out in the USA revealed that nearly one-third of responding institutions (32% of 567 institutions) offer faculty some kind of phased retirement option (Strage, 2018).

CONCLUSIONS

It is useless to keep repeating that the average age of university professors is on the rise because academia is not different from other sectors. Therefore, a debate on aging in research is as needed as for other professions. However, privileged access to knowledge gives special responsibilities to researchers. If age discrimination is actively practiced in academia, researchers will have no moral right to counteract it in other sectors of society. Changing paradigms will require that research on aging takes an integrative perspective on its biological, psychological, and sociological dimensions. Considering that in three decades one third of the European population will be over 65 years of age, with a life expectancy of 85 years, the status quo will strongly impact the lives of a large number of present young adults if action is not taken now. Borrowing a phrase that has been applied to climate change, we clearly have an "age emergency" to deal with.

A researcher may receive several awards in a successful career, some of them near the age of retirement. But what is the value of an award? According to Roberts et al. (2016), who conducted a query involving fellowship awardees in one psychiatric society, honorary fellowships represent: "Valuable mentorship; greater collaboration and networking opportunities; meeting leaders; receiving professional recognition; encountering talented peers; help advance one's scholarly, clinical, or other professional work; Identifying collaborators." Awards after a long and successful research career bring a complex combination of perceptions. It is not just about past experiences and achievements. For someone looking forward, an award has a lot to do with aspirations, opportunities, and improvement. Paul Ewart has defended that the 'emeritus' status "is of no use to experimental scientists who need a research team and principal-investigator status to apply for their own research funding" (Ewart, 2020). Traditional models of rewarding researchers who have the drive to pursue research are getting outdated and not meeting people's expectations.

In essence, mandatory (or compulsory) retirement of academic researchers who are scientifically active at the time of retirement is a practice that results from an ageist attitude that is based on old paradigms of career progression and has marginal effects on the creation of positions for new faculty. Also, it does not take advantage of intergenerational gains that result from a wide range of age distribution of academic staff. The reinvention of retirement schemes is already taking place in some universities, with benefits for institutions and retirees and should be applied more widely.

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Mário Barbosa » mbarbosa@i3s.up.pt » i3S – Instituto de Investigação e Inovação em Saúde da Universidade do Porto » Rua Alfredo Allen, 208 — 4200-135 Porto, Portugal » https://orcid.org/0000-0003-3568-7482.