EXPERIENCED EDUCATION AND LEARNING

Dr. Francesco Carlo Morabito

Member of Barcelona Economic Network
University Mediterranea of Reggio Calabria
Italy

Abstract

In this presentation, some aspects of ageing are investigated from different perspectives, which eventually show some unifying concepts relating the states of older and younger adults. The good and the bad of being senior in the present times are discussed by highlighting the advantages of a complementarity of the roles with younger adults in contrast to the narrative of a contraposition. The discussion will focus on looking at healthy aging through the lens of education and learning. It is then argued that some recent advances of neuroscience on brain studies show how the differences between younger and older adults are often motivated by neuroanatomical differences as they are shown by neuroimaging high-resolution inspection and functional MRI. A section of the paper is devoted to the potential impact of Artificial Intelligence (AI) for healthy aging. Finally, some paradigmatic and somehow stereotyped representations of elderly in the arts are discussed. The main conclusion of this work is that the care of elderly cannot be regarded as a waste of resources as our consumistic society tends to suggest; on the contrary, an inter-generational dialogue can be advantageous for the society as a whole.

Keywords: Neuroscience, Arts, Artificial Intelligence, Deep Learning, Ageing

Introduction

In this paper, the problematic issue of ageing is faced from the general perspective of learning and education.
The recently published report on population ageing of the European Commission (EU) has estimated the economic and budgetary impact of an ageing population over the long term, according to some previously agreed underlying assumptions and projection methodologies [1].
The world's population is ageing rapidly (between 2015 and 2030, people over 60 years is projected to grow from 1.0 to 1.4 billion, and to 2.1 in 2050).
The total population of the EU is projected to decline over the long term and the age structure will change significantly in the coming decades. In particular, the overall population is projected to shrink by 5% between 2019 (447 million) and 2070 (424 million), with wide differences in national population trends (i.e., increases in 11 Member States and falls in the others).

The ratio between people aged 65 years and over and those aged 20-64, which is referred to as EU's demographic old-age dependency ratio, is expected to strongly increase in the next decades. The present figures are as follows: from about 29% in 2010, it had risen to 34% in 2019 and is projected to rise further, to 59% in 2070 [1]. This would imply a shift from about four working-age people for every person aged 65 years and over in 2010 to around two in 2070. One of main reasons for this is related to the growth of life expectancy (at birth for males is projected to increase by 7.4 years over the period, from 78.7 in 2019 to 86.1 in 2070 in the EU, and for females by 6.1 years, from 84.2 in 2019 to 90.3 in 2070).
Accordingly, population ageing is believed to become one of the most significant social transformation of the present Century; indeed, for this societal challenge has been coined the colorful term *Silver Tsunami*.
Societal ageing has a direct implication for most aspects of human life including the social, economic, cultural, budgetary, and political domains. In particular, an increase in labour force participation rates is expected, especially among older workers, reflecting the effect of the estimated budgetary impact of pension reforms. As a direct consequence, understanding and providing ways for exploiting the effect of societal ageing appears to be a relevant issue of the society all over the world.
In this work, which has been presented at the XVth *Acto* of the *Royal Academy of Economic and Financial Sciences*, some aspects of aging are analyzed from different perspectives. In particular, the impact of education and learning is considered also in view of an active ageing; then, some advances of neuroscience studies are presented and the potential effect of AI on healthy aging is investigated. Finally, the way artists represented elderly in their artworks is briefly discussed through a brief analysis of some paradigmatic examples.

A model of active ageing

One of the most important aspects of ageing regards the possibility of maintaining good health in spite of the age. It is clear that this aspect has also a relevant impact on economic issues, as healthy elderly can possibly continue their work activities by reducing the burden on the welfare. However, active aging that has been defined as "… *the process of optimizing opportunities for health, participation and security in order to enhance quality of life as people age*", has many other non-budgetary implications, including the capacity of favoring an improved inter-generational collaboration. The World Health Organization (WHO) has proposed a model of active ageing based on optimizing the opportunities for health, participation, and security in order to enhance quality of life for people as they age [2]. Active elderly people with positive perceptions of self and ageing maintain their mental and physical fitness levels, participate in community associations and politics, and engage in a fruitful inter-generational dialogue [3].
However, seniors are not to be looked at as just consumer of resources: they yield a heritage embodied in their experience, knowledge, and wisdom that is to be appropriately regarded as a valuable and measurable resource for both the whole society and the same younger adults. The rather well known model reflecting this perspective is represented in the literature by Dante and Virgilio, which face together the heavy travel preciously described in the *Divina Commedia*.
The active aging model refers to six well defined groups of topics, each one including several features: (1) availability and use of health and social services (e.g., health promotion and prevention; continuous care); (2) behavioral determinants (e.g., exercise

and physical activity; drinking and smoking habits; feeding; medication); (3) personal determinants (biology and genetics, and psychological characteristics); (4) physical environment (e.g., safety houses, low pollution levels); (5) social determinants (e.g., education, social care), and (6) economic determinants (e.g., wage, social security). This group is complemented by two crosscutting determinants—gender and culture [4]. The objectives to be achieved are selected aiming to preserve the autonomy, the health, the social participation, and the quality of life of elderly. To achieve this goal, one of the main aspects to be kept into account is continuous learning.

The role of education and learning

Learning is something we experience throughout our whole lives. Learning new things is what we make every day and it becomes especially important in the senior years. It is a great way to keep the mind and body active and can play a big part in reaching serenity, maintaining health and even happiness.

Although this imply some opportune actions, i.e., reading, socialize, and exercise, the quite different other face of the coin is that older adults can offer to the development of the Society their richness and experience, which is the contrary to the perspective of welfare, i.e., of just analyzing the services to be given to seniors. In their past life, seniors have already faced some difficulties and can help others in coping with its complexity and nonlinearity, which are the invariable rules of our life.

The impact of education and learning in this respect cannot certainly be overestimated: in particular, it is well accepted that learning something new is a good way to boost self-esteem: when learning a new skill, you feel stronger, more confident, and proud of yourself. New skills can give also to older adults a stronger sense of independence, which will keep them happy and healthy.

Some studies suggested, indeed, that the belief and feeling of be smart, efficient and endowed with a strong mind can help prevent or delay memory loss and neurological degeneration. For example, it has been demonstrated in experimental trials that older people did worse on memory-related tasks after being exposed to negative stereotypes about seniors and forgetfulness. On the contrary, they performed better on the same tasks when they were told that it is possible to preserve memory well into later years.

By analyzing the impact of younger and older adults in the development of the society, however, it is fair to bearing in mind both cognitive and non-cognitive aspects.

Emotion, in particular, appears to be more relevant in older adults: they prevail in tasks where emotive involvement is needed, and this is related to neuro-anatomically different paths of activations in the brain.

New researches carried out at Stanford University show that aging adults play critical roles in the lives of young people, especially the most vulnerable in society. Volunteering, most often related somehow to emotion, is one way to bring older adults and young people together. The key is to change social norms to encourage relationships between generations, instead of building up fictitious walls between them.

When older adults contribute to the well-being of youth, it cultivates a sense of purpose and extends benefits both ways. Such relationships are important for the whole society: indeed, they can help ensure that young people receive the kind of attention and mentoring they often lack, especially among the most vulnerable populations

As a well-known example, these relationships offer older adults opportunities to learn about new technology and trends, and experience the excitement of seeing the world through a younger perspective.

Contrary to widespread beliefs that older populations consume resources that would otherwise go to youth, there is growing reason to think that older people may be just the resource youth need.
As people age, their brains actually improve in many ways, including in complex problem-solving and emotional skills: it would thus be a relevant loss for society not to offer such experience to others, especially to young people.

The perspective of neuroscience

In recent years, the study of brain, its organization, and its modifications along the years has been carried out by using novel technological diagnostic advances. Brain imaging studies demonstrated the relevance to understanding the mechanisms of cognitive aging first analyzed primarily by means of behavioral measurements.
Some new key discoveries, including evidence favoring plasticity and compensation mechanisms have emerged specifically from using cognitive neuroscience methods to study healthy aging.
The use of brain imaging technologies to evaluate the neural underpinnings and correlates of human behavior is changing the field of (neuro)-psychology.
New visions of the human mind are emerging from the integration of psychological science with brain science, and this is especially true for the field of cognitive aging.
One of the main results achieved is that there are important neuroanatomical differences in the younger and older brains, which are highlighted by functional Magnetic Resonance (fMRI) investigations.
Working memory, the cognitive system that actively maintains several pieces of information in mind for immediate use in higher-order processing tasks, has been considered prominently in cognitive theories of brain aging.
Performance differences between younger and older adults are generally minimal on simple span tasks or item recognition, whereas differences are pronounced when executive functions such as memory updating, reordering, or inhibition are added to the task (e.g., word or operation span).
Tasks likes item recognition, however, reveal pronounced activation differences, despite age-equivalent recognition accuracy, especially in regions of the prefrontal cortex (i.e., dorsolateral, inferior frontal gyrus).
In some experiments carried out on two groups of younger and older adults, where the memory load has been parametrically varied, it was revealed that both age groups generally recruit the same brain regions. However, older adults recruit more (in terms of stronger activation, more sites of activation or both) at lower objective memory loads compared with younger adults. This pattern of prefrontal over-activation suggests that older adults are engaging additional "executive" resources to support short-term memory maintenance [5].
This interpretation gains support from the finding that younger adults also recruit these additional prefrontal sites, but at higher objective memory loads.
Indeed, as load increases (e.g., greater than four work items), older adults typically perform more poorly than younger adults, and this kind of behavioral decline is shown by a reduced prefrontal activation for older compared to younger adults. This brain pattern is referred to as under-activation. This evidence has been interpreted suggesting that a sort of "resource ceiling" has been activated.
In these experimental trials, the neural correlates of memory success have been investigated by classifying trials from the encoding phase of the experiments based on

their memory outcome. These "subsequent memory" effects permit comparisons between encoding activity that leads to remembering versus forgetting.
Based on this approach, older adults commonly show limited activation in regions of the medial temporal lobe including hippocampus and para-hippocampus, but increased activation in prefrontal regions compared with younger adults. This prefrontal over-activations is interpreted as compensatory because they are associated with better memory performance.
To sum up the results achieved in experiments carried out in four specific cognitive domains (i.e., perception, memory encoding, memory retrieval and executive function), they have shown, in the average, that older adults engaged prefrontal regions more than younger adults. When performance was equivalent, it has been seen that older adults engaged left prefrontal cortex; in contrast, poorly performing older adults engaged right prefrontal cortex. Younger adults engaged occipital regions more than older adults, particularly when performance were different and, generically, during perceptual tasks. In the parietal lobes it seems there are no age-related differences [6].

Artificial Intelligence and the elderly

The methods of Artificial Intelligence (AI) applied to the field of aging research offer many interesting opportunities both for diagnoses and management of peculiar actions and activities. In what follows, the focus will be on one of these interdisciplinary frameworks.
Aging is a universal unifying feature possessed by all living organisms, tissues, and cells and being a continuous dynamic process can be detected well in advance to the external modifications. Deep Learning techniques, which are one of the main successful field of AI, have been used to develop age predictors or biomarkers. They yield novel possibilities for analyzing apparently confounding dynamic and static data types and evidences.
AI biomarkers of aging enable a holistic view of biological processes and allow for novel methods for building up causal models, by extracting the most important features from different aspects of each individual and identifying biological targets and mechanisms
Recent developments in two of the most innovative DL methodologies, i.e., Generative Adversarial Networks (GANs) and Reinforcement Learning (RL) permit the generation of diverse synthetic molecular and patient data, identification of novel biological targets, and generation of novel molecular compounds with desired properties.
These advanced approaches can be mixed into a unified real world evidence pipeline, in fields like longevity researches to design seamless end-to-end biomarker development, target identification, drug discovery, somehow helping accelerate and improve both pharmaceutical research and development practices.
AI is therefore expected to contribute to the credibility and prominence of longevity biotechnology in the healthcare and pharmaceutical industry, and to the convergence of countless areas of research, thus invoking interdisciplinary studies as a better way to solve societal problems [7].

Representation of elderly in the arts

In the literature, three different aspects seem to be the hallmark of successful aging, namely, reducing the risk of getting a disease, maintaining a high mental and physical functioning, and being actively engaged in life [8]. The ativities related to expressive art are certainly one of the opportunities to promote somehow an active engagement in life

[9]. Arts keep us engaged in life with a positive, healthy, and fulfilling prospect. Creative arts provide older adults with multiple potential benefits, among them enhanced cognitive functions. Expressive arts, including visual arts, music, dance, writing, and poetry, are empowering tools that can help to gain a good aging process. Some art activities, indeed, accompany therapeutic interventions for subjects diagnosed with chronic diseases, mainly neurological degeneration. Furthermore, art exercises represent innovative interventions to promote self-expression and improve communication with others, including younger adults.

It is well-known that art provides benefits for both the creator and the viewer. Current studies in the fields of creative modalities confirm that art can affect individuals in positive ways by inducing both psychological and physiological healing. Neuroscience research explains how making art can improve cognitive functions, i.e., by producing new neural pathways (thus enhancing the properties of small-worldness of the brain) and favoring thicker and stronger dendrites. In summary, art enhances elderly cognitive reserve, promoting the mechanism of compensation helping physiologycally the fight to pathology by the brain networks more efficiently or depicting alternative brain strategies. Most of the greatest artists represented elderly and the aging process in their artistical masterpieces. In what follows, a very reduced sample of artworks are briefly proposed, making special reference to the paradigms and the stereotyped vision they introduced.

Van Gogh, in "*Sower in the sunset*", 1888, [10] conveys a traditional positive vision of the experienced adult whose action can suggest the eternal cycle of life and the potential of elderly to continue life through seeds and the shining of sun filling the painting with a particular luminescence radiating outward. The sower is represented with the same texture of the background being part of a unique symbol of life.

The power of elderly and the positive impact on the society is paradigmatically represented in the "*Moses*", 1513-1515 and 1542, of Michelangelo Buonarroti [11], the great Renaissance marble statue housed in San Pietro in Vincoli, Rome. Moses has a biblic, serious attitude with an evident tension of the muscles projected against false idols, and, at the same time, protecting the Law in a combative pose. Coming to our times, it is perhaps possible to argue an attempt to fight fiercely the consumistic, environmental unfriendly way of life, often mentioned and blamed by Pope Francis. Sigmund Freud yielded an interesting interpretation of the Moses as he was an elderly patient whose emotional inner state is manifested through the aggressive pose [12].

"*El viejo guitarrista ciego*", Picasso, 1903, [13], can be analysed as a stereotyped representation of the weakness, abandonment, and misery of elderly; however, the guitar can suggest a strong propensity to life through the art and music, an ante litteram declaration then resumed by the successive neuroscience studies.

Caravaggio represented *Saint Jerome* in three painting, 1605-1606 [14]. Jerome is really very old, tired, and full of wrinkles as commonly imagined. Caravaggio does not give up any detail characterizing elderly, apart from the halo, perceptible with difficulty, on his head. This is a traditional representation conveying the unavoidable sense of death and the uselessness of earthly good in human life. However, notwithstanding the fatigue, St. Jerome transmits to all the viewers a clear idea of the need of refecting on the sense of life and of the strength of continuing to serve it and possibly younger generations.

In the Rembrandt's portrait "*Head of an old man in a cap*", circa 1629, [15], an elderly man with a stereotyped beard inclines his head thoughtfully. The man is directly illuminated from above, suggesting a divine intervention, with dark open eyes which are the reflection of a fully active inner life. This aged figure painted by Rembrandt is

immersed in a spiritual light and personify the piety and knowledge acquired over the course of a lifetime.
Globally considered, those different artworks realized in different times are just a selection of masterpieces that may reflect the considerations carried out in the previous paragraphs of this work.

Conclusions

At the end of the story, the different perspectives and motivations of younger and older adults are able to transmit life to each other: they are both needed to develop human society and there is an interchange of resources that ultimately reinforce life and allows its perpetuation. It is possible to summarize the ideas here proposed by referring to the Chapel Sistine *Creation of Adam* fresco, circa 1511, certainly one of the most important artworks in the history of universal art, an icon realized by Michelangelo Buonarrotti and depicting the creation as its subject. Here, the strength of a spark of divine creation passes by the tip of the fingers from God to his creature. Which image can represent better the inter-generational dialogue here advocated as the fundamental passage of experience and emotive way of learning from elderly to younger adults.

Acknowledgment

The author would like to thank the President Professor Jaime Gil-Aluja and the Steering Committee of RACEF for the invitation to make this presentation at the XVth meeting of the Royal Academy of Economic and Financial Sciences.

References

[1] EU Commission, The Ageing Report 2021, Institutional paper 142, November 2020, https://ec.europa.eu/info/publications/2021-ageing-report-underlying-assumptions-and-projection-methodologies_en
[2] WHO, Active aging: a policy framework, WHO/NMH/NPH/02.8
https://www.who.int/ageing/publications/active_ageing/en/
[3] Paúl C, Ribeiro O, Teixeira L. (2012). Active ageing: an empirical approach to the WHO model. *Curr Gerontol Geriatr Res* 2012:1–10.
[4] Fernández-Ballesteros R. (2008). *Active Aging: The Contribution of Psychology*. Gotttingen: Hogrefe Publishing
[5] Denburg NL, Cole CA, Hernandez M, et al. (2007). The orbitofrontal cortex, real-world decision-making, and normal aging. Annals of the New York Academy of Sciences, 1121: 480-498.
[6] Matthäus, F., Schmidt, J. P., Banerjee, A., Schulze, T. G., Demirakca, T., & Diener, C. (2012). Effects of age on the structure of functional connectivity networks during episodic and working memory demand. Brain connectivity, *2*(3), 113–124.
[7] Jiang F, Jiang Y, Zhi H, Dong Y, Li H, et al. (2017). Artificial intelligence in healthcare: past, present and future. Stroke Vasc Neurol. 2: 230-243.
[8] Bagan B., (2009). Expressive Arts, Aging, Alzheimer's and Parkinson's: A Manual for Artists, Sun Dance Creations
[9] Rowe, I.W., L. Kahn R.L, (1998). *Successful Aging*, The McArthur Foundation Studies
[10] https://www.vincentvangogh.org/sower-at-sunset.jsp

[11]https://www.walksinrome.com/blog/moses-by-michelangelo-san-pietro-in-vincoli-rome
[12]https://www.finestresullarte.info/opere-e-artisti/quando-il-mose-di-michelangelo-si-racconto-a-sigmund-freud
[13] https://www.ecured.cu/El_viejo_guitarrista_ciego
[14] https://borghese.gallery/collection/paintings/saint-jerome-writing.html
[15]https://agnes.queensu.ca/explore/collections/object/head-of-an-old-man-in-a-cap-2/