Leadership in an Ageing Society and the Brain: Applying Neuroscience to Leadership

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Abstract

"What makes a great leader?" This question has been on the minds of scientists, philosophers, professionals, and others around the globe for centuries. Many theories and models have been proposed to answer the question, but none has fully captured leadership as a dynamic and constantly evolving attitude. In the last 20 years, technological advancements have helped neuroscientists understand the human brain better. With the help of ground-breaking insights in neuroscience, the leadership enigma has a convincing answer rooted in a specific and very tangible source: the brain. This paper aims to increase awareness around the impact of the brain on leadership behaviour in an aging society by presenting secondary research of available scientific theory. In particular, this paper aims to provide an overview and assess the brain-based leadership models and recent approaches to highlight the possible ways to boost the leadership brain and enhance performance. The paper also points out the ethical issues arising from brain enhancement in leadership and leaders' awareness of the possible broad social consequences that neuro leadership might bring.

Keywords: leadership; brain; neuroscience; neuro leadership; brain-based; neuroethics; ageing society
JEL classification: D87, L29, M14, O15

Paper type: Research article
Received: 15 Mar 2022
Accepted: 8 May 2022

DOI: 10.54820/entrenova-2022-0007

Introduction

Our brain does not remain biologically unchanged during our professional life. It can do more or less, depending on how we use it. As the understanding of neuroscience increases, we can better see how scientific insights about the brain can be applied to develop and enhance leadership potential. Neuroleadership is the interdisciplinary field that links neuroscience to leadership. It addresses the leaders and the followers to take advantage of the brains to learn faster, perform better and achieve more in complex environments (Dimitriadis et al., 2020). In addition, an aging society is one of the most critical challenges of our time. It refers to the demographic changes in the population structure of most industrialised countries caused by falling birth rates and rising life expectancy (OECD, 2020).

Consequently, aging is changing how organisations operate and leaders lead. Hence, our main scientific aim is to examine the potential impact of the brain on leadership behaviour in an aging society. The following text provides an overview of research literature and proposes a possible way to boost the leadership brain and enhance performance in an aging society. Furthermore, we analyse the importance of neuroscience on leadership and explore the trend of an aging society in Slovenia and the EU. Finally, we present the results, discuss possible ways to boost the leadership brain in an aging society, and conclude with limitations to the study.

Leadership and the Brain

"What makes a great leader?" is a question to which we still do not have a clear and single answer. Leadership is one of the most observed social concepts on Earth, but it is still poorly understood (Burns, 2010). Experts agree that leadership is not an exact science. Nor is it pure art. Nor is it a collection of individual thoughts, feelings, or actions. Leadership is a relationship. Moreover, like any relationship, according to classical psychology theory, a relationship is simultaneously composed of thoughts, feelings, and behaviours (Rosenberg et al.,1960) in a sum greater than its parts.

Scientific studies that explore the literature on leadership (Pierce et al., 2014; Obolensky, 2014; Western, 2013; Stacey, 2012; Psychogios, 2007) categorise four main approaches or leadership styles:

- The autocratic-controlling *approach*, where the leader seeks and controls resources to enhance efficiency.
- The motivational-engagement approach, where the leader focuses on relationships and motivating others to enhance results.
- The transformational approach is where the leader aims to transform an organisation's culture, attempting to achieve better outcomes.
- The adaptive approach, where the leader sees organisations as complex systems evolving and, therefore, trying to adapt constantly.

Despite the accumulated knowledge of leadership formulated by various scientific disciplines, leadership is still not sufficiently reliably defined for interpretation to be generally accepted. Why? Because leadership is not a static phenomenon - it is a dynamic one that constantly evolves (Dimitriadis et al., 2020).

Moreover, we can also observe an evolutionary pattern in leadership development. On the following basis, a relatively new perspective on leadership has been developed - Evolutionary Leadership Theory (EvoL theory), which follows Darwin's logic and uses different approaches in leadership research as a result of physiological, neurological, and psychological processes influenced by continuous biological evolution (Vugt et al., 2018).

If once the emphasis on the understanding of leadership was primarily on psychology, today, there is an increasing turn to neuroscience (Dimitriadis et al., 2020). Furthermore, efforts to create a comprehensive and multidimensional leadership model are directing the researchers to find new ways to provide a more accurate insight into the individual's performance, capabilities, and behaviour. An answer rooted in the brain offers convincing and perhaps one of the most comprehensive answers to the questions posed above; "What makes a great leader?".

Modern neuroscience

We live in a time of rapid technological progress and increasingly rapid and complex environmental and societal changes. In the last few years, almost more discoveries have been made than in the 20th century. In particular, rapid technological progress has significantly contributed to the development of scientific sciences, which have lagged precisely due to the lack of technological progress. Undoubtedly, one such discipline is neuroscience - the science of the brain and the nervous system (Finger, 2001).

In 2014, the American Scientific Journal, which follows the most astonishing advances in science and technology, declared the 21st century a "century of the brain" due to advances and the importance of discoveries in neuroscience. In the last 20 years, new techniques such as special electrodes that can touch the surface of neurons, EEG and fMRI imaging devices of the human brain, and silicon chips with artificial brain networks have changed the face of modern neuroscience. (Boyatzis, 2014) They have given us new insights into the brain, neurological processes, development, and connection of neurons. As a result, they have strongly influenced our understanding of how brain function influences individual and social decision-making and, consequently, demonstrated individual and social behaviour (Banich et al., 2018).

Neuroscience development has helped us abandon the generally accepted belief that humans are rational beings, which has strongly influenced the systems and organisations in which we operate. Specifically, in 2004, Antonio Damasio refuted the belief that we think first and only then feel with the Somatic Markers Hypothesis and their Influence on Decision-Making. The scientific discovery mentioned above triggered changes in the economy and other scientific fields. The long-established notion of "Homo Economicus" has been abandoned in economic theory, which presupposes that a human is rational and makes only rational decisions. Behavioural economics has been established, spreading traditional economic theory and assuming that rational and analytical thinking is not a total capacity but irrational behaviour and decision-making (Thaler, 2018).

Neuroleadership

In 2009, Rock and Ringleb called the impact of neuroscience on leadership Neuroleadership. They defined it as the study of the biological micro-foundations of the interpersonal influence based-relationship among leaders and their followers. Neuroleadership claims that leaders can have a real advantage in engaging themselves and others toward enhanced performance (Rock et al.,2009).

The main aim of this dialogue between neuroscience and business organisations is to improve the management of the latter and both businesses' overall productivity and that of their employees. Therefore, the central concerns of neuroleadership focus on decision-making, memory, attention, motivation, and emotional intelligence. Drawing on these issues, team-building methods and a combination of

different leadership styles have become one of the central premises of the confluence between neuroscience and leadership (Medina-Vicent, 2019).

The initial models of neuroleadership were interpretations of the discoveries in neuroscience and their application to the concepts of leadership and management: neuroscience in leadership. The research areas in the emerging field of neuroleadership are grouped into four leadership activities:

- decision-making and problem-solving,
- emotional regulation and emotional intelligence,
- collaboration and influence, and
- change management (Rock et al., 2009).

Further research in neuroleadership suggests developmental theories that perceive leadership as more relational and brain-adjusted. Especially the term Homo Relational, as a relational aspect of social brain theory (interconnectivity, interrelatedness, and interaction), needs to be factored in if we want to explain and understand other leadership processes among leaders and followers (Dimitriadis et al., 2020). In addition, the following three models of neuroleadership have been developed to improve the quality of leadership and leadership development: the SCARF model (Rock et al., 2009), the BAL approach to leadership (Dimitriadis et al., 2020), and the CAMPS model (Luna, 2022). Table 1 presents the neuroleadership model.

The SCARF model (Rock, 2009) summarises important neuroscience discoveries about how people interact socially. The model is built on three central ideas:

- The brain treats many social threats and rewards with the same intensity as physical threats and rewards (Lieberman et al., 2009).
- The capacity to make decisions, solve problems and collaborate with others is generally reduced by a threat response and increased under a reward response (Elliot, 2008).
- The threat response is more intense and common and needs to be carefully minimised in social interactions (Baumeister et al., 2001).

The model involves five domains of human social experience:

- Status is about relative importance to others.
- Certainty concerns being able to predict the future.
- Autonomy provides a sense of control over events.
- Relatedness is a sense of safety with others - of a friend rather than a foe.
- Fairness is a perception of fair exchanges between people.

The model enables people to remember, recognise, and potentially modify the core social domains that drive human behaviour. Many studies have shown these five domains to activate the same reward circuitry that physical rewards activate, like money, and the same threat circuitry that physical threats, like pain, activate (Rock, 2009b). Understanding that these five domains are immediate needs helps individuals and leaders better navigate the social world in the workplace (Rock, 2009b).

The BAL (brain adaptive leadership) approach is a way of thinking, feeling, and acting within organised social entities. BAL is an attitudinal approach that individuals can follow to consider their brain and its influence on their behaviour to lead projects, processes, and people (Dimitriadis et al., 2020). The approach is based on three elements: the leader, the follower, and the context. The common denominator of those three elements is the human brain. By focusing on the brain and understanding its influence on our behaviour, we can: increase awareness of ourselves as leaders and understand better our limitations and abilities; increase awareness of others (followers)by understanding how others make decisions and are

motivated; and finally increase awareness of the context by understanding special features of the time, space and situation in which leadership occurs(Dimitriadis et al., 2020). There are four main pillars in the BAL approach:

- Thinking is the first pillar because leaders need to learn to think brain-based. Becoming a brain-based leader means maintaining and increasing willpower to deal efficiently and effectively with demanding situations. Leaders' awareness of cognitive biases of non-rational thinking, adopting meaningful purpose, pursuing flow, thinking creatively, having a strong memory, and having a growth mindset is essential (Dimitriadis et al., 2020).
- Emotions are the second pillar, as they reflect the emotional life of our brain. An individual cannot always understand and articulate his or her emotions, which is a significant challenge for leaders if we know that emotions motivate and motivate us to take action, not thoughts. The ability to perceive, recognise and categorise basic emotions is a virtue that is the foundation of successful leadership. The emotional agility of stimulating the desired emotion at the desired moment is an integrated part of the modern leadership style (Dimitriadis et al., 2020).
- Brain processes are the third pillar and reflect the autonomic responses and protocols of the brain. Decision-making and demonstrated behaviour are primarily based on brain processes beyond our awareness and control. The individual's unique response and interaction with environmental changes are also automated. The individual can alter automated responses and behaviours by creating new patterns and learning habits: unconscious incompetence, conscious incompetence, conscious competence, and unconscious competence (Dimitriadis et al., 2020).
- Relations are the fourth and the most important pillar, as it reflects the social aspect of leadership and connects the first three pillars. The brain is a social organ that needs to create meaningful relationships (connection, interaction, trust, and cooperation) to function properly (Dimitriadis et al., 2020). Relations are built and nurtured through communication, which must address all three major brain functions; to think (direct), to feel (motivate), and to act (patterns and habits).

The CAMPS model of brain-based leadership enables one to treat each person as unique and know how to anticipate and address the foundational human needs that all people share. We may express them differently and need different degrees and styles of support getting into those good " CAMPS", but we all share these foundational needs. The model is a quick gauge to check which "camp" someone is engaged or disengaged. Leaders who take this brain-based approach to leadership achieve better results faster while helping people bring out the best in themselves and one another (Luna, 2022). The CAMPS acronym stands for the five basic human brains craving that we all have in common:

- Certainty: One of the paradoxes of great leadership is guiding others into the unknown while offering a sense of certainty. There are three areas where leaders can best tend to followers' need for certainty; goals, roles, and norms.
- Autonomy: Complete certainty is unrealistic and not even desirable for our brains. Too much certainty can be mundane and uninspiring. The best antidote to too much certainty is autonomy – that sense of personal power. When we feel control over our lives, even the biggest challenges can become exciting. Leaders have three autonomy levels: choice, voice, and ownership.
- Meaning: A mix of certainty and autonomy are the two brain cravings that unleash greater focus and productivity. Nevertheless, these two needs alone

are insufficient to produce passionate engagement. The brain craving that holds that power is meaning. Two ways to keep the thread of meaning visible and tangible are personal benefit and impact on others.

- Progress: Harvard Business School researcher Teresa Amabile sifted through the distinguishing characteristics of what employees consider a "good day" and made an exciting discovery. On most good days, people reported experiencing a sense of progress. Progress spikes our dopamine level, which then spikes our engagement, fueling more progress in a glorious, virtuous productivity cycle. Progress can be fed in two ways: demarcate on micro-and macro-level and extract the learning.
- Social Inclusion: The need to belong is inextricably linked to our drive to survive and is deeply integrated with our brains. Unfortunately, leaders are uniquely positioned to create social inclusion in two ways: deliberate social inclusion and design-out bias.

Table 1
Neuroleadership models

MODEL	AUTHOR	MAIN RESULTS
SCARF MODEL	David Rock (2009)	The SCARF model is based on important discoveries from neuroscience about how people interact socially. Five social domains (status, certainty, autonomy, relatedness, and fairness) activate the same threat and reward responses in our brains that we rely on for physical survival. The model works by minimising perceived threats and maximising the positive feelings generated by reward. It is beneficial to use if there is a need to collaborate with or coach others or when the need to provide training and feedback.
Brain-adaptive leadership (BAL)approach	Nikolas Dimitriadis and Alexandros Psychogios (2020)	BAL is an attitudinal approach that individuals can follow to consider their brain and its influences on their behaviour to lead projects, processes, and people. The BAL approach consists of four pillars (thinking, emotions, brain automation, and relations). It is beneficial if there is a need to increase awareness as a leader and understand better limitations and abilities; increase awareness of others by understanding how others make decisions and are motivated; and increase awareness of the context by understanding the time, space, and situation in which leadership occurs.
Brain-based leadership: using the CAMPS model	Tania Luna (2022)	The CAMPS model is based on the five biggest brain cravings to understand employee engagement or disengagement better. It is designed to score five brain cravings; certainty, autonomy, meaning, progress, and socialness, on a scale of 1 to 10. Further actions and ideas are suggested to increase scores based on the scoring. It is beneficial to use if there is a need to manage people or when the need to manage employee engagement in remote workplaces.

Source: Author's research (2022)

In the extended definition, neuroleadership also includes care for improved brain function, stimulating brain capacity, and brain modification as a factor in better brain performance (Rock et al.,2009). In support of this view, there is evidence that leaders become more effective when stimulating themselves and their teams to use their brains' capacities better. The following is done mainly by enhancing individual brain strength, cultivating healthy relationships, and developing high-quality

collective thinking (Henson et al., 2013). Neurotechnology is on the rise, which on the one hand, creates high hopes for individuals with brain injuries. On the other hand, it enables so-called brain and mental doping as a possible response to current social challenges.

Ageing Society

We face a demographic phenomenon in Slovenia and other developed, market-oriented European Union (EU) countries. People today live longer, healthier, and more diverse life than ever before. The growing number of older Europeans, also known as the greying of Europe, is characterised by an increasing life expectancy and decreasing fertility rates. The total number of the older population in the EU is projected to increase significantly within the coming decades, with rising proportions of the post-war baby-boom generations retiring. By 2070 30% of all Europeans are estimated to be 65 and older, up from about 20,6% in 2020. Similarly, the old-age dependency ratio – a demographic indicator that measures the size of the population aged 65 and over relative to that of people at classic working ages (15 to 64 years old) is projected to increase by two-thirds in EU economies from 30% in 2020 to 50% in 2050. The following trend significantly contributes to the transformation of Europe's population pyramid shape (European Commission, 2020).

The population of the EU on 1 Jan 2021 was estimated at 447.2 million (Table 2). Young people (0 to 14 years old) made up 15.1 % of the EU's population, while people considered to be of working age (15 to 64 years old) accounted for 64.1 % of the population. Older people (aged 65 or over) had a 20.8 % share (an increase of 0.2 percentage points (pp) compared with the previous year and an increase of 3 pp compared with ten years earlier).

Table 2
Population projections for EU-27

Time	2020	2022	2024	2026	2028	2030
Age						
Share of 65 and over - elderly	20.72	21.39	22.07	22.80	23.53	24.32
Share of 15 to 64 - working age	64.19	63.72	63.30	62.84	62.30	61.69
Share of under 15 - children	15.09	14.89	14.62	14.37	14.17	13.99
Old-age dependency ratio (65 and over/15-64)	0.32	0.34	0.35	0.36	0.38	0.39
Total dependency ratio ((<20 & 65+) / 20-64)	0.69	0.71	0.72	0.74	0.75	0.77
The annual growth rate of the total population	..	0.08	0.05	0.03	0.01	0.00

Source: OECD.Stat (2022)

In Slovenia, the share of older people surpluses the share of young people in 2013. Since then, the gap in population has constantly been growing. For instance, in the last ten years, the share of children increased by 7% compared to the share of older people by 20.5%. Due to significant changes in the age structure of the 2,1 million Slovenian population, the population pyramid in 2019 took the shape of a vase known to EU societies. As the number of births decreases and mortality slows, the Slovenian population will continuously age. According to the Statistical Office Republic of Slovenia (SURS), the dynamic of population ageing in Slovenia is very fast, and based on their projections for 2059, the share of the population aged 65

and over will be 31% (compared to 20% in 2019). At the end of 2021, the average age of persons in employment was 43,3 years (Republic of Slovenia Statistical Office, 2022). Table 3 presents the population projections for Slovenia.

Table 3
Population projections for Slovenia

Sex	Total					
Country	Slovenia					
Time	2020	2022	2024	2026	2028	2030
Age						
Share of 65 and over - elderly	20.46	21.32	22.12	22.97	23.82	24.66
Share of 15 to 64 - working age	64.43	63.71	63.32	62.84	62.59	62.15
Share of under 15 - children	15.11	14.97	14.56	14.06	13.59	13.16
Old-age dependency ratio (65 and over/15-64)	0.32	0.33	0.35	0.36	0.38	0.40
Total dependency ratio ((<20 & 65+) / 20-64)	0.67	0.69	0.72	0.74	0.75	0.76
The annual growth rate of the total population	..	0.24	0.01	-0.06	-0.08	-0.10

Source: OECD.Stat (2022)

Transformation towards a much older population structure in Slovenia and Europe will significantly impact the workforce potential, meaning the share of the working-age population will decline in most EU countries (Van der Gaag et al., 2014). As many of Europe's public pension systems are based on the pay-as-you-go principle, fewer and fewer workers paying contributions to the pension system face more and more retired people receiving pensions. In addition, due to an increased life expectancy, these retired people live longer (Hofäcker et al., 2015). This development has increased concerns about the long-term financial sustainability of public pension systems. In some European countries, particularly with conservative welfare states, the challenges stemming from population ageing seem even more problematic as the early retirement policy has led to comparably low retirement ages. Based on the idea of the lump of labour and decreased unemployment rates, the early retirement policy offered older workers financially attractive early retirement options, allowing them to exit the labour market well before the state pension age with only small pension reductions (Hess et al., 2016). The following resulted in a disadvantageous ratio of retired over the working population. The old-age dependency ratio (a demographic indicator that measures the size of the population aged 65 and over relative to that of people at classic working ages 15-64) is projected to increase by two-thirds in EU-27 economies, from 30% in 2020 to 50% in 2050. EU countries are, therefore, in a swift demographic transformation process. Table 4 presents the overview of pensions in EU-27 and Slovenia.

Table 4
Pensions at a Glance in EU-27 and Slovenia

Year of labour market entry	2020					
Indicator	Current retirement ages for a person who entered the labour force at the age of 22		Effective labour market exit age		Expected years in retirement	
	men	women	men	women	men	women
Country						
Slovenia	62.0	62.0	61.5	60.5	20.7	25.6
European Union (27 countries)	64.3	63.5	63.1	61.7	19.4	24.0

Source: OECD. Stat (2022)

In response, European policymakers have implemented reforms aimed at extending working lives by delaying retirement timing and, hence, decreasing the number of people receiving pensions and increasing the number of people paying contributions. Additionally, in some countries, selected sectors—high technology, health and care, and crafts—face an increasing shortage of skilled workers (Brunello et al., 2019). Sustaining experienced and reliable older workers are one measure to mitigate this lack of skilled workers and ensure companies' competitiveness. Moreover, these reforms included closing early retirement options or making them financially less attractive, consequently making early retirement more expensive for older workers (Hofäcker, 2015). State pension ages were raised and, in some countries, are even indexed to life expectancy (Naegele et al., 2019). Furthermore, public pensions were lowered, and privatisation and marketisation elements were introduced to compensate for the lower incomes from public pensions (Ebbinghaus, 2016).

Ageing and Organisations

Further efforts were also made to strengthen older workers' workability and employability. Fighting ageism in the workplace and creating age-inclusive company cultures became more critical for policymakers and employers (Naegele et al., 2019). Investments in measures of life-long learning and training for older workers have increased, and the concept of a life-course-oriented human-resource strategy emphasises the importance of preventive healthcare programs at the workplace. The national and company efforts are supported by international organisations like the Organization for Economic Co-operation and Development (OECD) and the EU (Boppel et al., 2011). In particular, the role of the EU's Open Method of Co-ordination and its pension sustainability target to increase the employment rate of the 55–64-years-old to 50% or more played a crucial role. It seems as if the reforms have been effective as older workers' employment rates and retirement ages are increasing. Labour market participation at older ages has substantially increased since the turn of the century, and companies are using this new potential—employment rates of older workers have risen much more strongly than for the rest of the population, and this rise is marked across all education levels (OECD, 2020). However, the reforms that delay retirement are not the only potential explanation for these developments. The overall labour market development has been well, and the demand for workers has increased—at least in some European countries. In addition, today's older workers are healthier and better educated than their predecessors (Hess et al., 2018).

According to the current research, age diversity is a double-edged sword that impacts organisational effectiveness and innovation. On the one hand, age diversity can provoke emotional conflicts between individual team members and thus negatively influence the team's effectiveness. On the other hand, age diversity can contribute to developing new ideas and innovations by integrating different perspectives and knowledge levels within the team. These positive and negative effects of age diversity are influenced by the framework conditions within the organisation, such as leadership, team climate, or the cognitive abilities of individual team members (Dinnos, 2022). Moreover, organisations are also affected by demographic changes, reflecting that an age-heterogeneous composition of teams has become the norm.

Neurocognitive Ageing

As workers move throughout their careers, they learn new skills, obtain valuable experience, and become knowledgeable in their roles and the industry's critical details. However, this experience does not come without a trade-off. As these employees age, they can lose cognitive flexibility and sharpness as younger workers enter the organisation (Dimitriadis et al., 2020).

According to Grady (2012), the following brain changes usually occur with ageing:

- Brain mass: While brain volume decreases overall with age, the frontal lobe and hippocampus - specific brain areas responsible for cognitive functions - shrink more than other areas. The frontal lobes are located directly behind the forehead. They are the largest lobes in the human brain and are considered the human behaviour and emotional control centres for our personalities. The hippocampus is a complex brain structure embedded deep into the temporal lobe. It plays a significant role in learning and memory. Studies have shown that the hippocampus is susceptible to various neurological and psychiatric disorders.
- Cortical density: This refers to the thinning of the outer corrugated surface of the brain due to decreasing synaptic connections. Cortical thinning follows a pattern similar to volume loss and is particularly pronounced in the frontal lobes and parts of the temporal lobe. Lower density leads to fewer connections, contributing to slower cognitive processing. Our cerebral cortex, the wrinkled outer layer of the brain that contains neuronal cell bodies, also thins with age.
- White matter: White matter consists of myelinated nerve fibres bundled into tracts and transmitting nerve signals between brain cells. White matter is a vast, intertwining system of neural connections that join the brain's four lobes (frontal, temporal, parietal, and occipital) and the brain's emotion centre in the limbic system. Researchers believe that myelin shrinks with age, slowing processing and reducing cognitive function.
- Neurotransmitter systems: The brain begins to produce different levels of chemicals that affect neurotransmitters and protein production, ultimately leading to a decline in cognitive function.

The extent and the rapidity of cognitive decline vary among individuals. There is much evidence that cognitive decline is neither uniform among people nor is it uniform across the different cognitive functions of the brain. In other words, some 60-years-olds experience worse memory loss than other 70-year-olds, and one person may have excellent episodic memory but impaired executive control. This inter-individual variability is likely caused by biological, psychological, health-related,

environmental, and lifestyle factors and mechanisms. In general, however, the symptoms of cognitive decline that are associated with ageing include (1) slower inductive reasoning / slower problem solving, (2) diminished spatial orientation, (3) declines in perceptual speed, (4) decreased numeric ability, (5) losses in verbal memory and (6) few changes in verbal ability (Liu et al., 2017).

Cognitive ageing was once considered unavoidable or beyond the scope of treatment. Still, this complex process has become the scene of intensive investigations and stimulants of medicalised interventions of strategic importance. In 2019 the researchers designed a brain ageing model with three main factors: (1) risk categories, (2) brain drivers, and (3) gene variants. Based on those factors, the researchers are continuously developing new approaches and treatments that introduce scientifically-based solutions "to maintain brain health across the full extent of the adult lifespan." However, important questions arise about the characterisation of ageing brain treatment and its social, cultural, and biological assumptions (Liu et al., 2017).

Methodology

The aim of this paper was (1) to analyse the impact and the importance of neuroscience on leadership, (2) to analyse and explore the trend of an ageing society in Slovenia and the EU, (3) to provide an overview of research literature and propose the possible way to boost the leadership brain and enhance performance in an ageing society. Numerous world literature was reviewed to achieve the goals, exploring leadership, neuroscience, and ageing.

In identifying sources for this literature review, multiple databases were used. Initially, Google Scholar was utilised to take an initial sample of what types of articles were available. Regarding Google Scholar, broad search terms were initially used to establish a list of research articles that were the primary source and peer-review. In the begging, a basic search of neuroleadership and ageing society was used from the article titles and research data derived from Google Scholar; with that search basis, we could use a better list of more refined terms when utilising other databases to narrow search options. Through the University of Ljubljana School of Business and Economics search database selector, we used: EBSCO, EMERALD, PSYCARTICLES, OECD iLibrary, and EUROSTAT databases. Sources were analysed according to two main criteria. First, the source must be thematically aligned with the article's purpose. Second, the emphasis was on using secondary sources generated in the last ten years. While examining the data in the articles, we looked for indicators that proper research procedures were conducted to verify the reliability and validity.

Results

Table 5 presents the main papers identified about neuroscience and leadership. Four areas were discovered:

- Leadership and the Brain
- Ageing Society
- Neuroleadership model/approach
- Neuroethics – limitation of the study.

The authors analyse neuroscience's impact and importance on leadership in the first research group. Through the research, the authors demonstrated the significance of examining leadership from a neuroscientific perspective as it enables better leadership based on a tangible source: the brain.

In the second research group, the authors analyse and explore the trend of an ageing society. The authors presented the population ageing and its effects on society, systems, and organisations. Through the research, the authors examine the future challenges of population ageing.

The authors in the third research group provide a brain-based leadership model/approach to boost the leadership brain and enhance performance.

In the last research group, the authors provide an overview of ethical dilemmas in neuroleadership.

Table 5
Literature review of neuroscience and the leadership

Paper title	Construct
Becker et al., (2015). Leveraging neuroscience for smarter approaches to workplace intelligence. **Boyatzis, (2014). Possible contributions to leadership and management development from neuroscience.** **Butler et al., (2016) How organisational cognitive neuroscience can deepen understanding managerial decision making: A review of the recent literature and future directions.** **Henson et al., (2013). Brain Wise Leadership: Practical neuroscience to survive and thrive at work.** **Lindebaum et al., (2013). Not quite a revolution: Scrutinising organisational neuroscience in leadership studies.** **Medina-Vicent (2019). Neuroleadership: Diversity as a Moral Value in Organisations.**	Leadership and the Brain
Boehm et al., (2011). An integrated framework for investigating the challenges and opportunities of demographic change. **Brunello et al., (2019). Skill shortages and skill mismatch in Europe: A review of the literature.** **European Commission, (2020). European Commission report on the impact of demographic change.** **Grady, (2012). The cognitive neuroscience of ageing.** **Harper, (2015). The challenges of twenty-first-century demography.** **Hess et al., (2021). Planned Retirement Timing in Europe: Are Europeans Adapting to the Policy of Extending Working Lives.** **Holman et al., (2014). Indestructible plastic: the neuroscience of the new aging brain.**	Ageing Society
Dimitriadis et al., (2016). Neuroscience for leaders: A brain adaptive leadership approach. **Luna, (2022). Brain-based leadership: using the camps model.** **Rock et al., (2009). Defining NeuroLeadership as a field.**	Neuroleadership model/approach
Browning et al., (2022). On the relevance of experimental philosophy to neuroethics. **Clausen et al., (2015). Handbook of neuroethics.** **Farah, (2005). Neuroethics: the practical and the philosophical.**	Neuroethics – limitation of the study.

Source: Author's research (2022)

Discussion

Ground-breaking discoveries about neuroanatomy, synaptic development, and brain functioning significantly influenced how we understand the brain's inner workings and, more profoundly, our individual and social attitudes. As a consequence, the perspective of neuroleadership has evolved, and three main brain-based models and approaches have been introduced; the SCARF model

(Rock et al., 2009), the BAL approach to leadership (Dimitriadis et al., 2020), and the CAMPS model (Luna, 2022). The SCARF and CAMPS models, on the one hand, are the models that boost the leadership brain and enhance performance based on the social domain and basic human needs. On the other hand, the BAL approach to leadership is more holistic in understanding and implementing the leadership brain towards enhanced performance and leadership capabilities. It includes a broader scope of the brain mechanisms and is drawn on the knowledge of the brain from neuroscience, behavioural sciences, traditional leadership, psychology, and anthropology.

In addition, in the context of an ageing society, neuroleadership may be a part of a solution to this particular demographic challenge. As organisations are affected by an ageing workforce, which is reflected in the fact that an age-heterogeneous composition of teams has become the norm, and older workers are challenged with a neurocognitive decline in the workplace. The neuroleadership might boost the leadership brain and enhance performance in an ageing society in the following ways:

- Modifying the BAL approach to leadership (Dimitriadis et al., 2020) under the third pillar of the brain processes takes into account the factors that influence the aging process and effects brain processes.
- Brain stimulation and brain modifications are factors in better brain performance and brain de-aging.

Conclusion

This paper provides an overview of Neuroleadership and an overview of the Ageing Society. It also provides possible ways to boost the leadership brain in an ageing population, which has not been explored so far. As seen through the review of the research, the Neuroleadership in Ageing Society does not have specific research that would give an overview of the importance of Neuroleadership for the Ageing Society. However, for both, there is a common factor, the brain, which is the basis for added value and sustainable competitive advantage. With a visible lack of research in this area, it is a recommendation and goal for further study.

The study has certain limitations. First, the presented theoretical research article illuminates the impact of the brain on leadership behaviour in an ageing society but is not empirically validated. Empirical research is a potential avenue for further research to empirically highlight the connection between neuroleadership and an ageing society. Second, questions about the impact of neuroscience on society are collected under the general title of neuroethics, which is the crossroads of neuroscience, philosophy, and ethics. Neuroethics touches on ethical issues, which can be divided into three main categories: (1) risk to the individual and society in terms of health issues such as safety, side effects, and unintended consequences, (2) concerns about the social effects of brain strengthening and (3) philosophical issues related to the undermining of personality - personal effort, achievements, autonomy, moral responsibility and the like. Furthermore, neuroscience also opens up fundamental ethical dilemmas in neuroleadership, which requires all stakeholders' awareness of the potential wider social consequences it can bring. It must be understood that the primary purpose of neuroleadership is not to brainwash, read minds or manipulate people but to raise the level of an individual's thinking at all levels and deepen existing knowledge (Farah, 2005).

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