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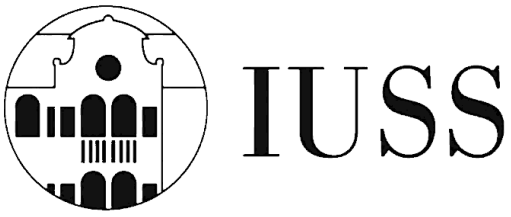

Social Vulnerability, susceptibility to scams and Altruism in Older adults with and without dementia

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Abstract

As the global population ages, understanding the effects of cognitive impairment on susceptibility to scams becomes increasingly important. This study investigates the relationship between altruistic behavior, cognitive functioning, and scam vulnerability in elderly individuals with normal cognitive functioning (NCF) and Mild Cognitive Impairment (MCI). A total of 119 participants, including 61 with MCI and 58 with NCF, were assessed using the ECRC Altruistic Scale, a donation task, and measures of social vulnerability and scam susceptibility. Results showed that individuals with MCI exhibited higher levels of altruism and greater susceptibility to scams compared to those with NCF. The study also found that while higher altruism correlated with increased scam susceptibility in those with cognitive impairment, it did not correlate with broader measures of social vulnerability. These findings underscore the impact of cognitive decline on social behaviors and highlight the need for targeted interventions to protect vulnerable elderly populations from financial exploitation.

Introduction

Altruism, defined as the selfless concern for the well-being of others, is a complex social behavior that has been extensively studied across various stages of life, particularly in the context of aging. As individuals grow older, the propensity to engage in altruistic behavior often becomes more pronounced, driven by factors such as life experiences, generativity, and an increased desire to contribute to the welfare of others. Research has consistently shown that altruism can have significant positive effects on the well-being of older adults, enhancing their mental health, life satisfaction, and overall quality of life (Kahana et al., 2013). These benefits are often attributed to the sense of purpose and social connectedness that altruistic acts provide. However, the relationship between altruism and aging is not without its complexities and potential drawbacks. Some studies have highlighted that excessive altruism can lead to negative outcomes for the elderly, including burnout, diminished financial decision-making abilities, and heightened vulnerability to exploitation as cognitive abilities decline (Bjälkebring et al., 2021; Wiesberger et al., 2022; Burnes et al., 2017).

One of the most concerning consequences of this vulnerability is the increased risk of falling victim to scams and financial exploitation. Older adults, particularly those who exhibit high levels of altruistic behavior, may be more susceptible to such risks, especially when cognitive impairments are present (Bailey et al., 2021; Weissberger et al., 2022). Susceptibility to scams and social vulnerability defined as the likelihood of being exploited is more pronounced in individuals with Mild Cognitive Impairment (MCI) and dementia (Pinsker et al., 2010; Boyle et al., 2019). Studies have shown a

strong link between diminished cognitive abilities and an increased risk of falling victim to scams, as well as a connection between lower cognitive functioning and heightened altruistic behavior (Rosi et al., 2019; Weissberger et al., 2022). This relationship suggests that as cognitive decline progresses, the capacity to make sound judgments in social and financial contexts diminishes, potentially leading to increased susceptibility to fraud.

Despite the growing body of research on this topic, a critical gap remains in the literature. To date, no study has explicitly examined the relationship between increased altruistic behavior and greater social vulnerability and susceptibility to scams in elderly individuals across both normal and pathological aging. This gap is particularly significant given the rapidly aging population and the increasing prevalence of cognitive impairments, both of which could exacerbate the risks associated with excessive altruism in this demographic. Addressing this gap is essential for developing targeted interventions that can protect vulnerable elderly individuals from exploitation while also supporting their altruistic tendencies safely and constructively.

The current study, conducted as part of the ProAging project, seeks to fill this gap by exploring whether there is a correlation between prosocial behavior, social vulnerability, and susceptibility to fraud in a sample of elderly individuals with normal cognitive functioning (NCF) and those with Mild Cognitive Impairment (MCI). The primary aim of the research is to investigate the potential link between altruistic behavior and susceptibility to scams, considering the moderating role of cognitive impairment. In addition to this primary objective, the study also addresses several secondary aims, including comparing levels of altruistic behavior, social vulnerability, and susceptibility to scams between elderly individuals with and without cognitive impairments.

Furthermore, the study explores the relationship between cognitive abilities and these variables to determine how cognitive decline may influence prosociality, social vulnerability, and susceptibility to fraud.

To achieve these objectives, the research was conducted as a prospective, cross-sectional study involving 119 participants, divided into two groups: 61 older adults diagnosed with Mild Cognitive Impairment (MCI group) and 58 with Normal Cognitive Functioning (NCF group). Participants were recruited from diverse sources, including the Neurological Institute IRCCS Mondino Foundation and the general population. The inclusion criteria required participants to be over 64 years of age and to have more than five years of education. The study employed a comprehensive methodological approach to assess the relationship between altruistic behavior, social vulnerability, and susceptibility to scams among elderly individuals, with a particular focus on differences between those with and without cognitive impairments.

Each participant underwent a thorough neuropsychological evaluation, including a battery of tests aimed at assessing various cognitive functions such as global cognitive functioning (MMSE), cognitive reserve (CRIQ), attention (TMT A-B, Digit Span), verbal memory (RAVLT), and executive function (FAB).In addition to these cognitive assessments, specific tools were used to measure altruism (ECRC Altruistic Scale), social vulnerability (Social Vulnerability Scale), and susceptibility to scams (Susceptibility to Scam Scale, Scams Questionnaire). A unique aspect of the methodology was the inclusion of a donation task, designed to assess current altruistic behavior. Participants were asked to imagine winning 100 euros and were given the option to donate part or all of it to a person in need, with the amount donated serving as a measure of altruistic behavior.

The statistical analysis was conducted using the Statistical Package for the Social Sciences (SPSS) software, focusing on exploring the relationship between altruistic behavior and susceptibility to scams. Descriptive statistics, Pearson correlation analysis, and further analyses including t-tests, ANOVA, and non-parametric tests were employed to investigate differences between the MCI and NCF groups. “The significance level for all tests was set at 0.05”.

This thesis is structured into 3 chapters, each contributing to a comprehensive understanding of the research topic. Chapter 1: The introduction sets the stage by providing an overview of the theoretical background, identifying the gap in the literature, and outlining the aims of the research, Literature Review delves deeper into the existing body of knowledge, discussing relevant theories and previous research, identifying gaps, and presenting the conceptual framework that informs the study. Chapter 2: Methodology details the research design, participant characteristics, measures used, procedures followed, and statistical methods employed, Results present the findings, including descriptive statistics and outcomes of the primary and secondary analyses, with a focus on the relationships between key variables. Chapter 3: Discussion interprets these findings in the context of the hypotheses and existing literature, explores the practical implications, acknowledges the study's limitations, and suggests avenues for future research, a Conclusion summarizes the main findings, offers final remarks on the study's contributions, and suggests potential directions for future work. Finally, the thesis concludes with a References section, listing all cited works

Chapter 1

1. Social vulnerability, Altruism and susceptibility to scam in older Adults with and without Dementia

In the realm of aging research, particular attention has been directed toward understanding prosocial behavior, notably altruism, concerning older adults, as highlighted by studies like Sparrow et al. (2021). Altruism, which includes selfless concern for others' well-being and the willingness to be involved in actions perceived as beneficial, embodies a diverse range of behaviors, such as kindness, generosity, sharing, giving, and aiding (Penner et al., 2005; Eisenberg et al., 1997). Prosocial behavior, rooted in empathy towards others (Batson et al., 1981), has been extensively examined, even within financial decision-making contexts where individuals may incur personal costs to aid others (Andreoni, 1989). Empirical investigations, notably utilizing self-report measures, have consistently indicated that older adults exhibit greater prosocial behavior compared to their younger counterparts (Freund & Blanchard-Fields, 2014). The underlying reasons for this increase in altruistic behavior among older adults have spurred academic debate. Some scholars propose intrinsic value orientations and shifts in motivational priorities, while others emphasize the influence of augmented external resources such as time and money (Brandtstädter et al., 2010; Wiepking & James, 2012). Furthermore, it has been suggested that increased altruism in older adults might stem from psychological factors leading to enhanced positive emotions and overall well-being (Aknin et al., 2011). Studies examining altruism have delved into its intricate relationship with cognitive processes. Notably, Mayr and Freund (2020) and Rand (2016) have posited that altruistic behavior is influenced by cognitive mechanisms. Interestingly, Mayr and

Freund (2020) propose that the heightened altruism observed in older adults might be attributed to cognitive decline, leading to a reduced ability to inhibit automatic and intuitive prosocial behavior. Moreover, this cognitive decline has been associated with the development of mild cognitive impairment and, in some cases, progressing to Alzheimer's dementia (Okonkwo et al., 2008; Martin et al., 2018). Recent studies have cast light on mild cognitive decline in older adults, indicating their vulnerability to decreased scam awareness, which could serve as an early manifestation of pathological diseases (Karlawish, 2019; Han et al., 2015).

1.1. Aging

Aging is a multifaceted process that encompasses various physical, cognitive, emotional, chronological, biological, psychological, and sociocultural dimensions of an individual's existence. Chronological age refers to the number of years a person has lived since birth, serving as a fundamental marker for tracking the passage of time (Baltes, Reese, & Lipsitt, 1980) Biologically, age is associated with physiological changes in organ systems, tissues, and cells, collectively known as aging. These changes manifest in a decline of functional capacity, increased susceptibility to diseases, and alterations in hormonal regulation (López-Otín et al., 2013) Physically, aging is associated with a reduction in bone density, muscle strength, endurance, and flexibility, which can impact coordination, stability, and balance (Stefanacci, 2023, Stefanacci, 2023). Psychologically, age is linked to cognitive development, personality maturation, and emotional well-being. Socially, age categorizations establish norms, expectations, and roles within communities, influencing individuals' experiences and opportunities (Elder Jr, 1998).

Cognitive changes in aging include declines in the speed of processing, working memory, and executive function, while cumulative knowledge and experiential skills are generally well-maintained (Murman, 2015) The dynamic interplay of these dimensions shapes the complex nature of age, impacting individuals across the lifespan.

1.1.1. Healthy Aging (Normal Aging)

Fields in research have shed light on the concepts of healthy aging which encompasses aspects of aging including social and psychological well-being; and emphasizes the importance of preserving abilities, physical health, and mental health well-being for functioning and independence in later stages of life. The concept of successful aging was used as the state of being free from disease or disease-related disabilities coupled with high cognitive and physical functioning and active participation in life (Rowe & Kahn, 1997) correspondingly, an alternative perspective termed effective aging was proposed in the literature to underscore the importance of adaptation and rehabilitation even in the presence of health deficits such as chronic conditions or disabilities (Curb et al., 1990) The theoretical constructs in the research field provide diverse lenses through which the aging process is understood and give a clear insight into the multifaceted nature of aging experiences. Strategies focused on promoting aging often involve making lifestyle changes such as engaging in physical activities and effectively participating in social activities (Lautenschlager et al., 2008) Interventions focused on health such as Training and mental stimulation have shown promise in mitigating age-related decline according to research studies conducted by (Ball et al., 2002) The

significance and support and community involvement have been highlighted as factors that foster a sense of belonging and purpose among older adults (Berkman et al., 2000)

1.1.2. Neurocognitive Changes

The natural aging process has been extensively studied in scientific literature, revealing that certain cognitive skills, like vocabulary, tend to withstand the effects of aging and may even get better over time. On the flip side, abilities such as conceptual reasoning, memory, and processing speed gradually diminish with age. Older individuals exhibit varying rates of decline in certain skills, such as perceptual reasoning and processing speed, highlighting the diversity in cognitive changes among the elderly (Wisdom et al., 2012) & (Murman, 2015)

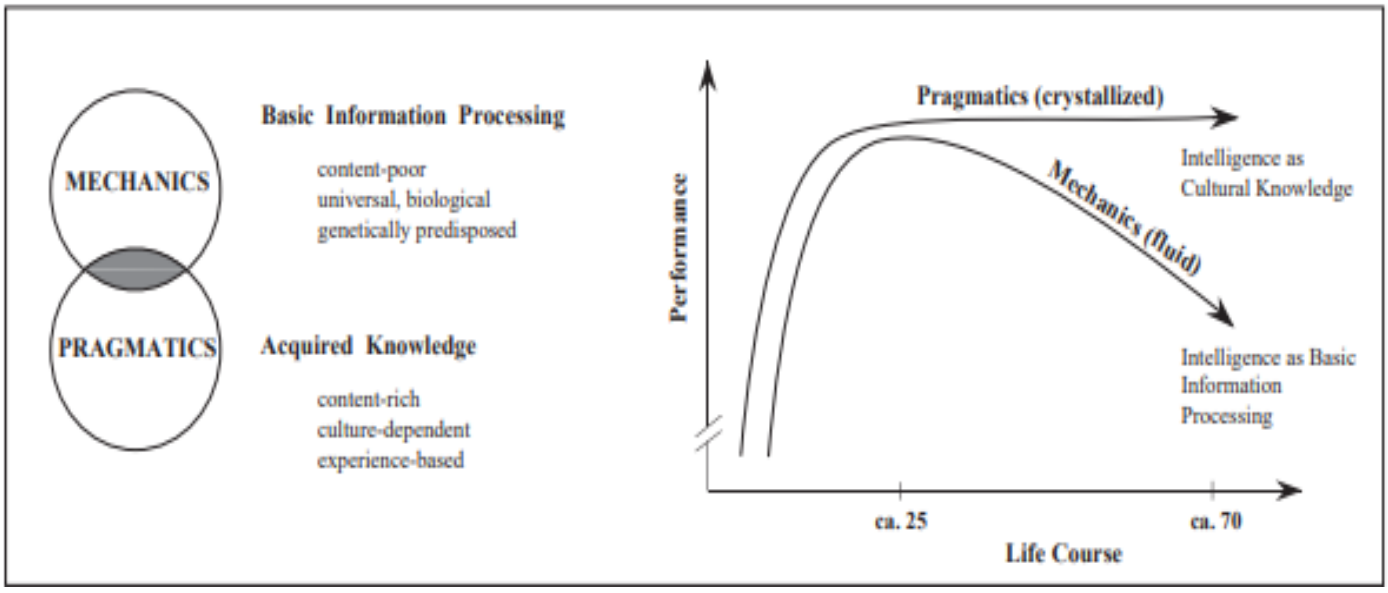
1.1.2.1. Crystallized Intelligence.

The concepts of crystallized and fluid intelligence serve as frameworks for delineating cognitive shifts throughout one's life. Crystallized intelligence encompasses well-versed skills, abilities, and knowledge acquired through extensive practice and familiarity (Lezak, M. D. 2004) Some of examples of crystallized skills such as general knowledge and vocabulary. Due to the accumulated information from life experiences, crystallized intelligence tends to remain stable or even show improvement over time. Older adults typically outperform their younger counterparts in tasks that demand this type of intelligence (Salthouse, 2012) & (Hagberg B. 2001)

1.1.2.2. Fluid Intelligence.

Fluid intelligence pertains to skills related to problem-solving and reasoning in unfamiliar contexts, distinct from acquired knowledge. It encompasses an individual's inherent capacity to process and acquire new information, tackle problems, and engage with and adapt to their surroundings (Elias & Saucier, 2006) Executive function, processing speed, memory, and psychomotor ability fall within the domain of fluid cognition. Numerous fluid cognitive skills, particularly psychomotor ability and processing speed, reach their pick in the third decade of life, after which they experience a decline at an approximate rate of −0.02 standard deviations per year (Salthouse, 2012) & (Aichele et al., 2015)

Figure 1: Research on lifespan cognition often focuses on two key components: fluid mechanics and crystallized pragmatics. “The left panel defines the categories; the right panel illustrates postulated lifespan trajectories” (Baltes et al., 1999)



1.1.2.3. Language.

Language is a multifaceted cognitive area, that includes both crystallized cognitive and fluid cognitive capacities. The overall proficiency in a language tends to endure as individuals age. Vocabulary, in particular, remains steady and may even enhance over time (Park et Reuter Lorenz, 2009 & Salthouse 2009). Still, there are some exceptions to this overall stability. For illustration, visual confrontation naming, the capability to recognize and name familiar objects, stays relatively consistent until around age of 70, after which it begins to decline in the subsequent years (Zec et al, 2005) Verbal fluency, the capacity to conduct a word search and produce words related to a specific category (such as letters or animal names) within a set time, also experiences a decline as individuals age (Salthouse., 2010 & Singh-Manoux et al.,2012)

1.1.2.4. Attention.

Attention, a multifaceted concept, plays a pivotal role in our engagement with the environment (Petersen & Posner, 2012; Harvey, 2019). It supports various cognitive processes such as working memory and executive functions (McCabe et al., 2010). There are several types of attention: sustained attention, which involves the ability to maintain focus over time (Buchtel, 1989); divided attention, which enables responding to multiple tasks simultaneously or handling various aspects within a complex task (Sohlberg et al., 1989; Stuss et al., 1989); selective attention, which allows individuals to concentrate on specific information while ignoring irrelevant stimuli (Salthouse et al., 1995; Carlson et al., 1995); and focused attention, the capacity to concentrate on one task without distraction (Rogers, 2000).

Selective attention, according to Rogers (2000), shows sensitivity to age differences, particularly depending on the task's nature. In contrast, focused attention tends to be weaker in older adults, suggesting a decline in their ability to sustain concentration on singular stimuli. Sustained attention, crucial for maintaining focus over extended periods, diminishes with age, with deficits becoming apparent after the age of 70 (Filley and Cullum, 1994). Age-related declines in performance are observed in divided attention tasks, especially in complex scenarios, possibly due to increased task complexity demanding more mental operations (Glisky, 2007). Moreover, the ability to shift attention also varies with age, with older adults exhibiting slower performance in global task-switching compared to younger counterparts. However, differences become less pronounced in local task-switching situations where both mental task sets are kept active (Mayr et al., 2001; Verhaeghen and Cerella, 2002; Wasylyshyn et al., 2011; Rogers, 2000).

1.1.2.5. Processing Speed.

The phenomenon of age-related decline in processing speed has been extensively documented in many scientific literatures, reflecting a widely recognized cognitive change that occurs with aging. Many studies have consistently reported a decline in processing speed as individuals advance in age (Salthouse, 1996; Deary et al., 2010). The aging process is associated with an increased vulnerability to Cognitive impairment and even dementia (Park & Reuter-Lorenz,2009) Processing speed is a critical component of cognitive functioning, covering the duration it takes for a person to perceive, interpret, and react to information. As the brain ages, structural and functional changes, such as reductions in white matter integrity and alterations in neural connectivity, contribute to the observed decline in processing speed (Buckner, 2004; Madden et al., 2017).

Additionally, age-related declines in processing speed have been associated with decreased efficiency in various cognitive domains, including working memory and executive functions (Salthouse, 2000; Finkel et al., 2007). While the decline in processing speed is a consistent finding, it is crucial to acknowledge variations across individuals and recognize potential moderating factors, such as genetics, physical health, and lifestyle choices, that may influence the trajectory of age-related cognitive decline (Lindenberger & Baltes, 1994; Kramer et al., 2009) A comprehensive understanding of these factors can be important for developing targeted interventions and strategies to mitigate the impact of processing speed decline on cognitive function in older adults. (Karmer 2009 reference missing)

1.1.2.6. Visual Processing Speed.

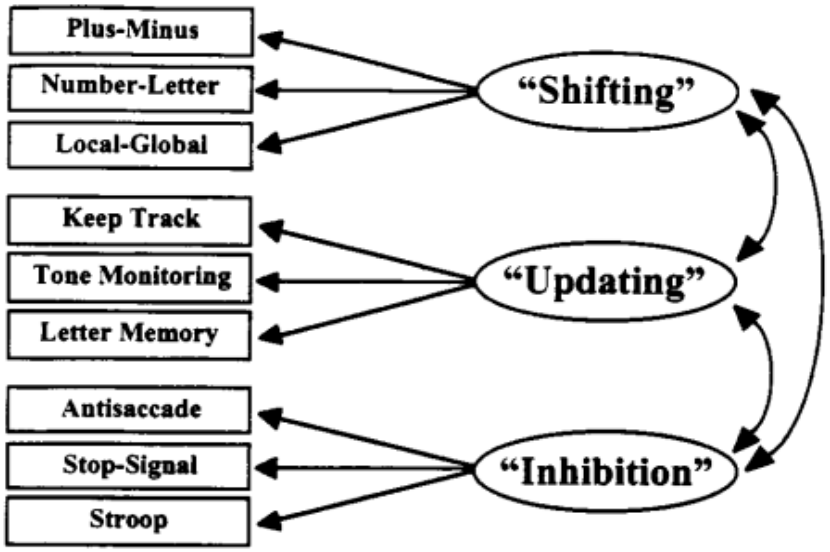
Recent literature gives importance to the critical role of Visual processing speed (VPS) in understanding cognitive aging and its implication for independence in older adults, studies have highlighted the association between age and the decline in VPS as individuals age (McAvinue, Habekost, et al., 2012; Ruiz-Rizzo et al., 2019), especially in those at risk of dementia (Ruiz-Rizzo et al., 2017) Given that VPS is integral to tasks involving visual information processing, its reduction influences overall cognitive performance, and execution of daily activities (Deary et al 2010; Park & Reuter-Lorenz, 2009)

1.1.2.7. Executive Function.

Executive function is well known in the literature as a cognitive process that is involved in goal-directed behavior and mental control, including abilities such as planning, organizing, problem-solving decision-making, shifting, and updating,

inhibiting impulsive responses (Diamond,2013) & (Miyake et al., 2000). problems in Executive function can indicate cognitive impairment in older adults which lead to everyday difficulties that can indicate also AD diseases progression (Ready, Ott, Grace, & Cahn-Weiner,2003) Research conducted by Belleville et al. (2017) and Borella et al. (2013) provides a closer look at the intricate changes that occurs in different aspects of executive function as individual age and have elucidated subtle patterns of both decline and preservation within distinct elements of executive function. Neuroimaging studies, particularly those discussed by Colette (2006) explore the cerebral substrates of executive functioning. These investigations reveal a distributed network involving both frontal and posterior (mainly parietal) regions challenging the notion of exclusive reliance on anterior cerebral areas. Despite diversity in implicated areas for different executive processes and tasks, research utilizing conjunction and interaction analyses confirms the role of parietal areas while highlighting specificity in neural substrates for processes like updating, shifting, and inhibition (Miyake et al. 2000).

Figure 2: The three aspects of executive functions (updating, inhibition, and shifting) proposed by Miyake et al. (2000) and example tasks related.



1.1.2.8. Decision Making.

Decision-making in older adults is a complex process that is influenced by cognitive decline, social influences, and emotional factors, even in the absence of Mild cognitive decline and Alzheimer's disease older adults are led to have poor decision-making, this is due to complexity of decision-making which requires higher-order cognitive functions that may deteriorate with age (Murman, 2011; Boyle et al., 2012).

cognitive factors especially influence Decision-making decline, one of the most critical changes in cognition with normal aging is the decline in performance on cognitive tasks that require quick processing or transformation of information to make the decision, this includes speed of processing, working memory, and executive function, especially in subjects older than 70. (Murman, 2015) age differences in cognitive abilities have long been considered the primary factor behind age-related variations in decision strategies

and outcomes, a key dynamic involving age-related changes in cognition that can have determinantal effects on judgment involves age decrements in core decision-making resources, such as fluid cognitive processing. The effects of age on decision-making depend on the type of decision situation (i.e., ambiguous or risky) in combination with the complexity of the decision-making task (Brand & Markowitsch, 2009; Löckenhoff, 2017). Moreover, there is an indication that cognitive abilities and decision-making process may not consistently correspond during the aging process. Although effective decision-making necessitates a specific cognitive capacity, approximately 25% of elderly individuals exhibit variations exceeding a standard unit between their decision-making skills and overall cognitive capabilities. This implies that decision-making is linked to factors beyond cognition, supporting the assertion that decision-making ability and cognition are distinct constructs in old age (Han, Boyle, James, Yu, Barnes, et al., 2015).

The involvement of emotion is crucial in the decision-making process for older individuals. Studies indicate that older adults might prioritize intact emotional processes over diminishing deliberative processes when making decisions. Relying on emotional reactions can result in decision-making outcomes of comparable quality to those observed in younger adults, particularly when employing affective strategies (Joseph A. Mikels & David B. Taullahu, 2023; Chen et Ma . 2009).

Social influences also significantly impact decision-making in older adults. Theories suggest that changes in cognition, emotion, motivation, and experience across adulthood can lead older adults to sometimes outperform or underperform in reward-maximizing decision tasks relative to young adults. For instance, older adults may show differential sensitivity to time delays, lower probabilities, and physical effort demands when making social decisions. This is consistent with socioemotional selectivity theory,

which posits that shrinking time horizons in older age leads to systematic changes in goals and preferences. (Seaman et al. 2016; Doekhie et al. 2020).

Decision-making in older adults with MCI or Alzheimer's disease poses a multifaceted challenge, that impacts older adults' daily lives. It is recommended by Investigates that more seasoned grown-ups with MCI may battle with regular Decision-making with the condition related to more regrettable decision-making, This is upheld by a consider that older adults with MCI exhibited poorer decision-making abilities than cognitively normal older adults (Fenton et al., 2023) it was discovered that MCI has the potential to impact financial decision making and healthcare for instance, a study found that MCI was associated with poorer decision making in financial and healthcare matters which are crucial for maintaining well-being and independence in old age (Han, Boyle, James, Yu, & Bennett, 2015) Moreover; a longitudinal study found that MCI impact also Medical decision-making capacity, patients with MCI showed a progressive decline in the ability to understand consent information over three years; this decline accelerates after conversion to Alzheimer's disease, reflecting the influence of the disease on Decision-making capacity (Okonkwo et al., 2008)

In Alzheimer's disease, difficulties in decision-making may arise from the memory challenges inherent to the condition. while studies suggest that poor decision-making may be a very early sign of impending AD (Boyle et al., 2019. Stewart et al. 2019). These memory deficits hinder patients from forming new connections between stimuli and rewards, as well as from discarding previously acquired responses. This aspect of the disease contributes to the struggles individuals face when making decisions (Bailén et al., 2017) However, it is crucial to emphasize that research findings do not suggest that older

adults with MCI cannot make sound decisions autonomously. Rather they may find it beneficial to seek assistance with specific decision types, such as financial choices or determining the safety of continuing to drive (George & George, 2023)

1.2. Memory Decline in Older Adults

Memory changes are a frequent cognitive concern among older individuals. In comparison to younger adults, older adults generally exhibit lower performance on various learning and memory assessments (Luszcz & Bryan, 1998) Research suggests that Memory decline is a complex issue that has gained significant importance in recent years. Age-related memory decline can manifest in multiple ways such as taking longer to learn new information, forgetting important events or appointments, and misplacing items frequently. At the same time, a degree of forgetfulness is considered a normal part of aging, and more severe memory problems can interfere with daily functioning and may be indicative of mild cognitive impairment or dementia (Memory, forgetfulness, and aging: what's normal and what's not? s. d.) Various aspects of memory as working memory, prospective memory, and episodic memory tend to decline with advancing aging (Nyberg et al., 2012; Murman, 2015)

1.2.1. Short-Term Memory

Numerous studies have demonstrated that short-term memory tends to decline with age, a study showed that STM performance starts decreasing after the age of 35 (Barrouillet et al., 2023) Another study discovered that older adults had more difficulty with short-term memory tasks compared to younger adults (Devitt & Schacter, 2016) these findings suggest a decline in STM as individuals age. This age-related decline in short-term memory is a result of various factors, including alterations in neural structures,

such as the hippocampus and prefrontal cortex, which play crucial roles in memory processes (Raz et al., 2005; Nyberg et al., 2012) Researchers (Bäckman et al., 2006; Bäckman & Nyberg, 2013) have pointed to changes in neurotransmitter systems, specifically lower levels of acetylcholine and dopamine, as contributors to the weakening of short-term memory in older individuals.

A recent study by Čepukaitytė et al. (2023) found that both short-term memory and long-term memory declined from early to late adulthood, Interestingly, there was a significant dating among short- and long-term period reminiscence performance, which continued throughout the age range. This suggests a common vulnerability to healthy aging for short- and long-term memories sharing the same spatial-contextual associations.

1.2.2. Working Memory

Working memory which underlies the temporary storage and manipulation of information, research studies has shown that WM in older adults declines with age (Bopp & Verhaeghen, 2005), but is modulated by factors such as gender and education, studies of healthy older adults, by using span performance, found that age negatively impacted WM abilities as did memory load with worse performance at higher loads. However, education level was positively associated with WM, greater age, and lower education level were associated with lower scores in neuropsychological tests, and both age and education interacted with gender (Pliatsikas et al., 2018) & (Fournet et al., 2012) Additionally, WM decline in normal aging has been a topic of interest, with some studies suggesting that visuospatial working memory may exhibit a greater age-related decline than verbal working memory (Klencklen et al., 2017).

1.2.3. Long term Memory

Long-term memory decline in older adults has been found in numerous studies, revealing alterations in neural structures like the hippocampus (Raz et al., 2005; Nyberg et al., 2012) including the roles of genetic and environmental factors (Fan et al., 2019; Schomaker et al. 2022). As previously mentioned, it has been shown that both short-term and long-term memories decline with healthy aging, suggesting a common vulnerability to the aging process (Čepukaitytė et al. 2023). Exploration by Wearn et al. (2020) discovered that a test measuring accelerated long-term forgetting over a 4-week period could prognosticate cognitive decline in healthy-aged grown-ups. This indicates that certain memory assessments might serve as early indicators of cognitive decline.

1.2.4. Episodic Memory

Episodic memory, the capability to recollect particular gests including details of what, when, and where events passed, is integral to cognitive function (Tulving, 1985), The decline of episodic memory in aging individualities is intricately linked to alterations in functional connectivity within the brain. specially, these changes not only mark the natural aging process but also serve as sensitive indicators for neurodegenerative diseases. While in younger adults, hippocampal-cortical functional connectivity stands out as a predictor for memory changes, the dynamics shift in older adults, in this demographic, alterations in cortico-striatal functional connectivity emerge as key factors associated with variations in episodic memory recall (Kinugawa et al. 2013; Fjell et al. 2015; Burgess et al., 2002; Markowitsch & Staniloiu, 2011). The study published by (Nyberg et al., 1996) showed that an age-related decline in episodic memory has been associated with changes in the medial temporal lobe (Persson et al., 2005), including the hippocampus

(Rajah et al., 2010) and amygdala, (LeDoux, 2007) as well as the frontal cortex and diencephalic structures (Van Petten et al., 2004). Furthermore, it is shown also a decrease in activation of the hippocampus and entorhinal cortex in older adults during episodic memory tasks (Alm et al., 2022)

1.2.5. Semantic Memory

Semantic memory, which encompasses general world knowledge such as word meanings, concepts, and facts, is of particular interest in the study of older adults due to potential age-related changes (Saumier & Chertkow, 2002). Some studies show that semantic memory remains relatively intact or even improves in certain knowledge domains with age, while other studies indicate a decline in semantic memory organization, which can affect diverse cognitive functions. Understanding the nature of this decline, its underlying mechanisms, and the factors that may influence it is crucial for developing effective interventions to support cognitive function in older age (Lalla et al., 2022; Cosgrove et al., 2023). Furthermore, In the study "Stability, Growth, and Decline in Adult Life Span Development of Declarative Memory," the researchers examined the evolution of episodic and semantic memory across adulthood. Utilizing data from the Betula Study, the research involved 829 participants from 10 age cohorts, tested 5 years apart. Key findings include :

- Episodic Memory: Contrary to the gradational decline suggested by cross-sectional analyses, longitudinal data revealed episodic memory remains stable until around age 60.

- Semantic Memory: The study observed slight improvements until age 55, followed by a slower decline in old age, indicating a more resilient trajectory for semantic memory.
- Cohort Differences: Discrepancies between cross-sectional and longitudinal findings were partly attributed to variations in educational attainment across cohorts, highlighting the influence of cohort-related factors on memory development and decline.

These findings challenge the early onset decline in episodic memory suggested by cross-sectional data, emphasizing the complexity of cognitive aging and the resilience of certain memory types into later life. The study underscores the importance of longitudinal data and cohort considerations in accurately capturing memory development and decline trajectories. (Rönnlund et al., 2005)

Figure 3: Estimated memory change across age (T scores) for the episodic and semantic memory factors on the base of longitudinal.

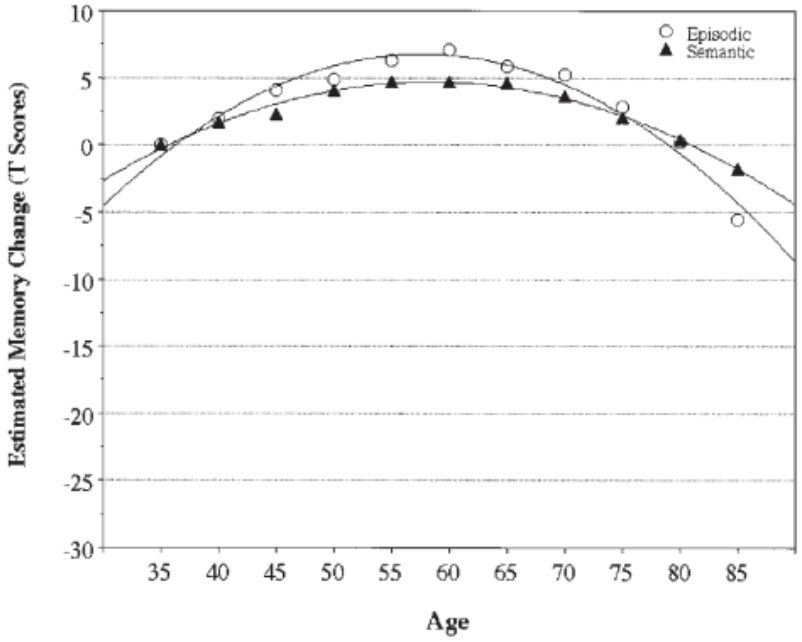
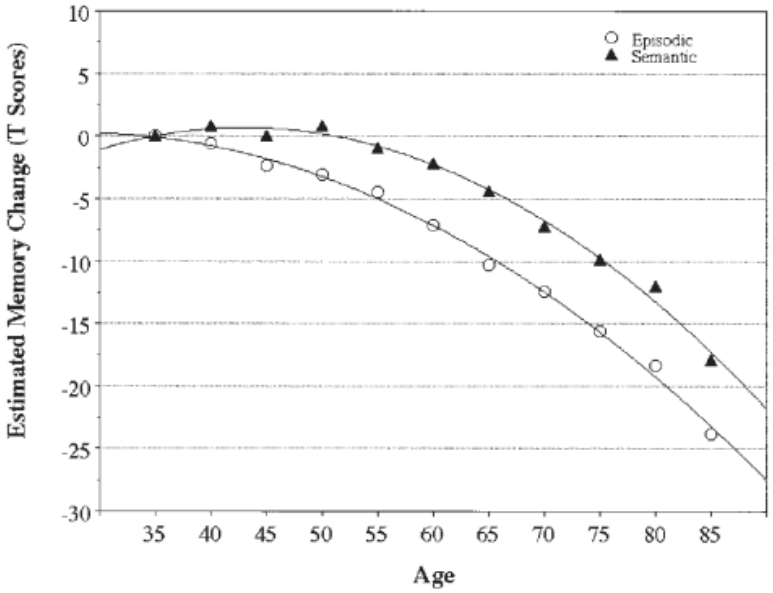


Figure 4: Estimated memory changes across age (T scores) for episodic and semantic memory on the base of cross-sectional data



1.2.6. Causes of Memory Decline

Multiple factors contribute to memory decline in older adults, one of the most common causes is neurodegenerative diseases such as Alzheimer's disease and vascular dementia which lead to irreversible loss of brain tissue and impaired cognitive functions Moreover several other medical conditions can contribute to memory decline such as Infections, Depression and side effects of certain medications (Borelli et al., 2020) For example, conditions like hypothyroidism, vitamin B12 deficiency, and excessive effects of consuming Alcohol can lead to memory problems (Do memory problems always mean Alzheimer's disease? , s. d.; (Smith, 2023) Furthermore, emotional problems can exacerbate memory problems (Borelli et al., 2020). On the other hand, Specialists have shown that adopting a healthy lifestyle, including mental stimulation, a balanced diet, and regular physical activities potentially slows down memory decline (Jia et al., 2023)

1.3. Structural and Functional Brain Changes with Aging

1.3.1. Gray Matter Changes

Grey matter volume starts to drop after the age of 20, with the most significant reduction occurring in the prefrontal cortex (Terry & Katzman, 2001). In a study carried out by Hafkemeijer et al.,2014, it was observed that as individuals age, there is a reduction in gray matter volume within networks that encompass subcortical structures, sensorimotor structures, as well as the posterior and anterior cingulate cortices. Conversely, the gray matter volume in networks associated with temporal, auditory, and cerebellar regions appear to be relatively unaffected by the aging process. One potential factor contributing to this decline is the death of neurons, a process that is particularly problematic due to the limited cell division and increased opportunities for mutations to accumulate (Uttara et al., 2009). However, an alternative explanation for grey matter volume loss in normal aging lies in the reduction of neuronal size and synaptic density rather than the actual death of neurons. Despite the different propositions suggesting neuronal loss, the decline in slate grey matter volume among older adults is more directly attributed to the drop in both the size of neurons and the connections between them (Terry & Katzman, 2001 & Resnick et al., 2003)

1.3.2. White Matter Changes

Salat et al. (1999) revealed that White matter experiences more significant volume reduction than grey matter during aging. A morphometric study, utilizing autopsy data from neurologically normal subjects, revealed a 16–20% decrease in white matter volume in individuals over 70 years old compared to younger counterparts (Meier-Ruge et al.,

1992) Despite the limited sample size in these studies, similar findings are supported by other studies, including reduced parahippocampal white matter, affecting communication with hippocampal structures, and suggesting a possible mechanism underlying age-related memory decline (Rogalskı et al. 2012). Beyond structural changes, diffusion tensor imaging (DTI) reveals functional declines in white matter integrity with age. O'Sullivan et al. (2001) demonstrated age-related declines in white matter tract integrity, especially in the anterior white matter, associated with executive function deficits. Madden et al. (2008) suggested that loss of integrity in the central corpus callosum may mediate age-related cognitive decline.

1.4. Mild Cognitive Impairment in Older Adult

Mild cognitive impairment represents a critical state between normal age-related cognitive decline and more severe conditions similar as Alzheimer's disease. Diagnosed individuals with mild cognitive impairment exhibit cognitive impairment beyond what is expected for their age but without significant interference in daily activities. Usually includes Memory, Attention, Language, and executive function surpassing the expected cognitive decline related to regular aging. These declines are particularly evident in tasks requiring complex cognitive processes, problem-solving, and decision-making abilities. This condition has gained substantial attention in the field of cognitive neurosciences due to the predicted progress to more severe forms of dementia. Episodic memory and working memory are often prominent with individuals experiencing difficulties in recalling events or retaining new information, Attentional decline in MCI involves the reduced ability to focus, sustain attention or task-switching, and executive functions involve planning, organizing, and goal-directed behavior are frequently compromised

impact individuals to manage daily life activities. (Peterson et al. 2009; Winblad et al. 2004; DeCarli, 2003)

1.4.1. Subjective Cognitive Impairment

Before demonstratable cognitive impairment, many elderly individuals experience a subjective decline in memory or other cognitive domains (Mielke et al., 2012) The identification of subjective cognitive decline (SCD) in elderly individuals is becoming more acknowledged as a potential sign of atypical cognitive deterioration, potentially leading to the development of dementia over time (Reisberg et al., 2010 & Mitchell et al. 2014). In a seminal contribution to this discourse, Yue et al. (2020) emphasize the significance of taking subjective cognitive complaints into account as potential early indicators of more pronounced cognitive decline, including the progression from Mild cognitive impairment to Alzheimer's disease.

1.4.2. Types of Mild Cognitive Impairment

1.4.2.1. Amnesia.

Amnestic Mild Cognitive Impairment (aMCI) is characterized by a focus, on memory loss. Is linked to an increased likelihood of progressing into Alzheimer's disease. People, with aMCI may struggle with recalling conversations, misplacing objects, and forgetting appointments or social gatherings. (Harvard Health, 2021).

1.4.2.2. Non-Amnesia.

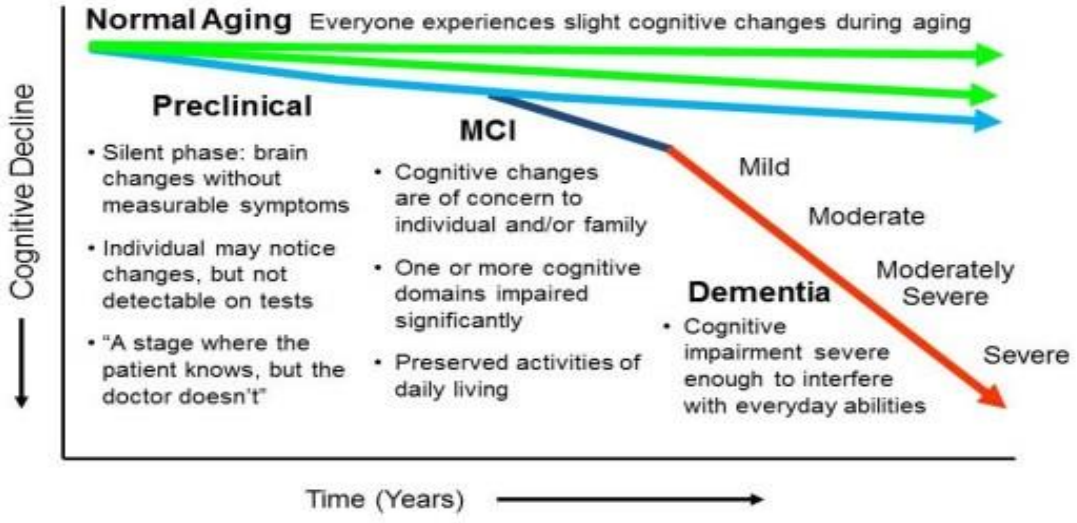
In non-amnestic mild cognitive impairment (naMCI), individuals experience challenges in cognitive areas beyond just memory, such as language, visual-spatial skills,

or executive functioning. People with naMCI face an increased risk of transitioning to other types of dementia, like diffuse Lewy body dementia. This means that the difficulties extend beyond memory issues, encompassing various aspects of cognitive function, and highlight the potential progression to more severe forms of cognitive decline, In naMCI, memory remains intact, but one or more other cognitive abilities may be significantly impaired (UCI MIND, 2017; Csukly et al. 2016).

1.4.3. Single Domain vs. Multiple Domain MCI

When it comes to Mild Cognitive Impairment (MCI), there are two main types: Single Domain and Multiple Domain. In single-domain MCI, only memory or one specific area of thinking is impacted. On the other hand, multiple-domain MCI involves not only memory issues but also affects one or more additional cognitive abilities (UCI MIND, 2017)

Figure 5: Progression from normal aging to Alzheimer's disease or another dementia



1.4.4. Causes of Mild Cognitive Impairment

Mild cognitive Impairment is influenced by various factors, contributing to its onset and progression. Genetic factors play a significant role, with studies suggesting that genetic polymorphisms may increase susceptibility to MCI, though the precise mechanisms remain under exploration (Wang et al., 2020). Age is another significant factor, with the risk of MCI rising as individuals grow older. Additionally, the presence of the APOE e4 gene further heightens susceptibility to MCI (Fan et al., 2019). Moreover, Brain changes associated with MCI mirror those observed in Alzheimer's disease and other dementias, albeit to a lesser degree. Autopsy studies reveal the presence of beta-amyloid plaques, tau protein tangles, and Lewy bodies in individuals with MCI. Brain imaging studies further demonstrate structural changes, including hippocampal atrophy, ventricular enlargement, and decreased glucose utilization in key brain regions. Various medical conditions and lifestyle factors, such as diabetes, hypertension, obesity, depression, and sleep disorders, also contribute to the risk of developing MCI (Mayo Clinic, 2024).

Lifestyle choices also play a crucial role in MCI risk. Factors such as low educational attainment, solitary living arrangements, smoking, and a diet high in fats have been associated with increased vulnerability to MCI. Conversely, engaging in regular physical exercise, maintaining a socially active lifestyle, and adhering to a nutritious diet may help mitigate the risk. Surprisingly, healthy habits and hobbies have been linked to a reduced incidence of MCI (Zou et al., 2019).

1.4.5. Healthy Aging VS Pathological Aging

Aging as a natural process characterized by social behavioral physical, biological and psychological changes, however, it can be challenging to differentiate between normal processes linked to aging and pathological ones, certain behaviors that are not usually common in pathological aging may be inferred as regular, leading to a further cognitive and behavioral transition that may have been addressed or managed if the correct diagnostic was known (Understanding The Dynamics Of The Aging Process, s. d.), one of the main differences is the progression of changes, researchers suggest that normal aging is now no longer connected to speedy and unexpected cognitive decline like a pathological one (Harada et al., 2013) older adults with age-related health issues like dementia or Alzheimer often experience a sudden and profound inability to concentrate, recall memories or to assimilate new information, in contrast of normal aging is not accompanied by such severe and fast decline in one's typical behavior, and if present, changes in behavior are difficult to detect since they occur gradually (Salthouse, 2019). As we age, our cognitive abilities tend to slow down, especially when it comes to tasks that require quick decision-making, such as processing speed, working memory, and executive function (Saunders & Summers, 2011). However, our accumulated knowledge and skills remain robust even in our later years. These cognitive shifts align with changes in our brain's structure and function, including neuronal modifications, synapse loss, and network dysfunction, without necessarily leading to neuronal death. Age-related diseases can hasten these processes, leading to significant cognitive decline and impairments that can affect daily life for many individuals (Murman, 2015). A problem that older adults suffer from is isolation which can be due to social changes, such a tendency is related to age-related conditions which can be caused by individuals in society that don't make them

feel belonging. Thus, social withdrawal is linked with neuropathology and is often the case with older adults with health issues (Kosel et al.,2020 & Hämmig, 2019 & Ayalon et al., 2020) we can point to other signs such as aggression and violence which can be an associated symptom of dementia and is not counted as a profile of normal aging (Davies et al., 2018) Risk factors associated with dementia including insufficient engagement in physical and mental activities. Conversely, the presence of these activities has been linked to a reduction in the incidence of dementia, and an active lifestyle is important to maintain a low chance of pathological aging (Sun et al., 2019)

1.5. Prosocial Behavior and Altruism in Aging

Prosocial behavior is characterized as diverse sorts of behavior that point to advantage others, Charitableness is considered as a prosocial behavior too such as making a difference, sharing, and comforting (Eisenberg et al., 1997), Penner et al. (2005) proposed a framework for understanding prosocial behavior across three analytical levels. Firstly, the micro level examines individuals internally, exploring the origins and variations in their prosocial tendencies and dispositions. Secondly, the meso level zooms in on interpersonal interactions, specifically the dynamics of helper-recipient relationships within specific contexts, where one person assists another. Lastly, the macro level broadens the scope to encompass prosocial actions within larger social structures, like groups or organizations, encompassing activities such as volunteering and cooperation.

According to Taylor (2010), Altruism is a collection of behaviors that are cross-cultural and spread through societies and across the world and it is seen as a positive behavior that is selfless and natural. It is suggested that Altruism can be defined as a

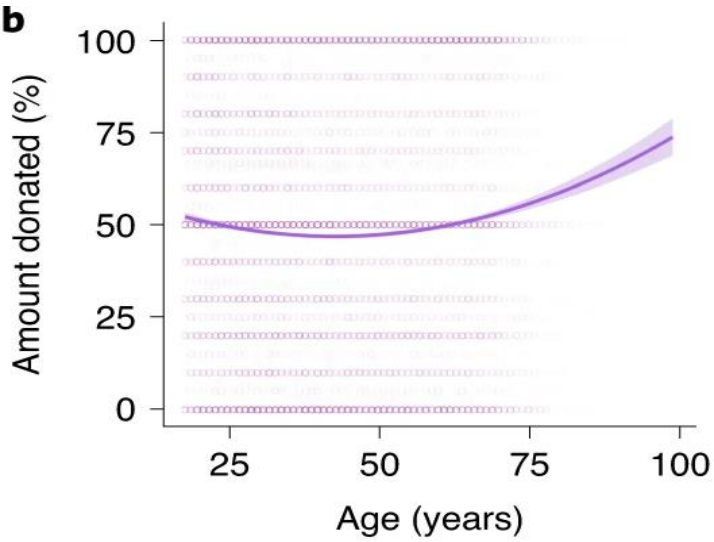
prosocial behavior when it is performed voluntarily, to aid and seek to do good to others without any anticipation of return (Leeds,1963) it derived and it is a result of Tender emotions (McDougall,1908), biologically people tend to recognize the emotional need of others that make them have an emotional reaction to affect other' mental state (Eisenberg & Strayer, 1987). Studies are showing that prosocial behavior produces positive emotions and a decrease in negative emotions. For example, a study by Aknin (2011) showed that prosocial behavior leads to an increase in happiness after participants spend money on others in contrast to participants who did not regardless of the amount they spent, showing that a higher level of happiness predicted a greater willingness to engage in prosocial spending and create a positive feedback loop with happiness, also this positive emotion leads to social contact and engagement with others.

1.5.1. Altruism in Aging

Numeric studies showed that pattern of Altruism changes through the life span, Altruistic behaviors tend to increase with age, and older adults are more likely to behave altruistically and donate for example money to a good cause (Freund & Blanchard-Fields, 2014) with consistent findings suggesting that older adults tend to be more altruistic compared to younger adults. For instance, Midlarsky and Hannah (1989) found that elderly individuals demonstrated more altruism and generosity than other age groups in donation scenarios. Sparrow and Spaniol (2018) conducted two experiments using an intertemporal choice task involving older and younger adults. Their study provided evidence for an age-related increase in altruism, particularly demonstrated in intertemporal choices involving gains, losses and donations. Cutler et al., (2021) found that age positively predicted prosociality, with increased distancing and donations among older adults (see figure 6). Furthermore, a meta-analysis by Sparrow et al. (2021)

combined data from 16 studies assessing altruism in younger and older adults. The analysis showed notable age-related differences, with older adults showing more altruistic behaviors than their younger individuals. Collectively, these studies suggest a consistent pattern of greater altruism among older adults compared to younger adults, highlighting age as a significant factor in altruistic behavior.

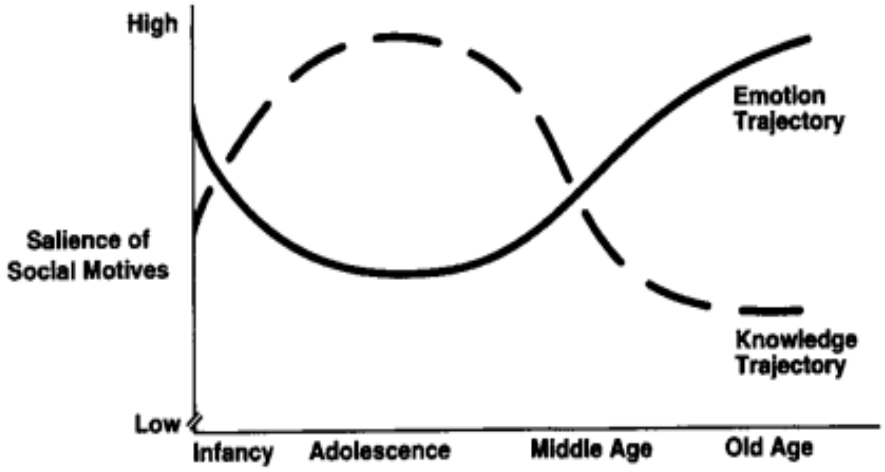
Figure 6: Older age predicted higher rates of hypothetical charitable donations.



As long as some literature agrees that Altruism increases through the lifespan, researchers started investigating what makes and what are the factors and the motives that result in the increase of Altruism in Older Adults. As an example of that, the Socioemotional Selectivity Theory (SST) illustrates how the motivations of older adults shift toward pursuing prosocial goals. (see figure 7) As individuals perceive time as open-ended, they are more inclined to prioritize acquiring knowledge-based goals that cater to future needs. However, with the realization of a limited time horizon as they age, there is a tendency to focus more on present-focused socioemotional goals. Prosocial behavior, in this context, is shaped by internal motivational processes influenced by perceptions of

time and considerations about who will benefit from the assistance. (Carstensen et al., 1999)

Figure 7: A simplified representation of the Socioemotional Selectivity Theory's understanding of the significance of two categories of social motives throughout individuals' lives.



1.5.2. Factors Influencing Altruism in Aging

Altruistic tendencies increase with adult development, as suggested by lifespan theories. This phenomenon is attributed to goals like ego-transcendence, generativity, and emotion regulation. Perspectives propose that this rise in altruism during old age may result from a shift in intrinsic value orientations and motivational priorities, or be influenced by age-related increments in external resources (such as time and financial means). Moreover, the wealth of life experiences and wisdom gained with age depends on older adults' understanding of the importance of helping others, as noted by Wiepkig & James (2012) and Bekker & Wiepking (2007).

1.5.2.1. Increased Empathy and Emotions

Older adults often exhibit heightened empathic concern and improved perspective-taking abilities, leading to increased altruistic tendencies. Empathic concern entails emotions directed towards others, in alignment with their perceived well-being, characterized by feelings of warmth, compassion, tenderness, and genuine concern for their welfare when they are in need (Batson,2010). Research studies, such as those by Beadle et al. (2013), and O'Brien et al. (2012) have explored age-related differences in prosocial behavior and empathy. Older adults tend to exhibit greater prosocial behavior and emotional empathy compared to younger adults, as evidenced by studies using methods like the dictator game found higher levels of emotional empathy in older adults, especially those with elevated trait cognitive empathy. Similarly, research efforts by Sze et al. (2012) have shown age-related increases in emotional empathy and prosocial behavior, particularly in response to distressing and uplifting stimuli. These findings contrast with declines in cognitive empathy and other cognitive and physical functions associated with aging. Empathic concern appears to contribute to the escalation of prosocial behavior with age. Similarly in the context of dictator Game finding showed that older adults tended to be more prosocial, especially when the recipient was portrayed positively. This behavior seemed to be linked to a decline in reasoning ability among older adults. The study explored the impact of factors like empathic concern, Theory of Mind, and general cognitive functioning on decision-making. However, it was exploratory in nature due to conflicting hypotheses in existing literature. The findings suggested that older adults' increased prosocial behavior in socio-economic decision-making might be tied to a decline in reasoning ability with age, and they might be more influenced by positive

social cues about the recipient (Rosi et al., 2019) on the other hand, findings suggest that as people age, basic dispositions (traits) like agreeableness drive prosocial acts in daily life rather than empathic concern, highlighting the complex interplay between personality, empathy, and prosocial behavior across the lifespan (Cavallini et al., 2021)

1.5.2.2. Cognitive Changes.

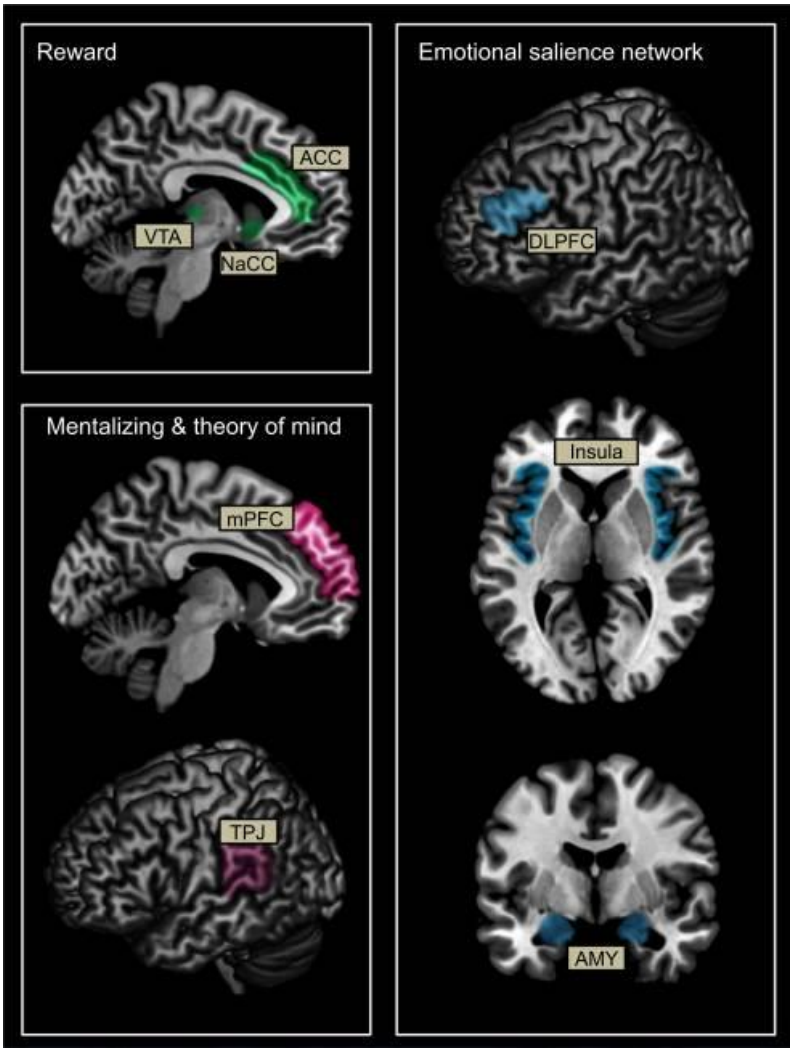
Studies provide valuable insights into age-related differences in prosocial behavior and their underlying mechanisms. In a study by Corrêa et al. (2020), the relationship between altruism, volunteering, and cognitive performance in older adults was explored. Altruism and volunteering were found to have distinct associations with cognitive tests. Volunteering was correlated with lower cognitive decline, whereas altruism was associated with higher absolute scores on cognitive tests. This suggests that while volunteering may help mitigate cognitive decline, altruism contributes to better cognitive performance overall. Corrêa et al. (2018) investigated the impact of altruistic behavior on cognition in older individuals. Their findings suggested a positive correlation between altruism and cognitive performance, indicating that individuals who exhibit more altruistic tendencies tend to have better cognitive functioning. These results suggest that promoting altruistic behaviors could potentially help maintain cognitive abilities in aging populations. Opposite to the discoveries of past considers, Weissberger et al. (2022) discovered a negative association between altruism and performance on various neuropsychological tests. Greater altruism was linked to poorer performance in areas such as list learning and recall, delayed story recall, picture naming, and animal fluency. This novel finding challenges prior research that had reported positive associations between altruism and neuropsychological functioning.

The discrepancy between studies could be attributed to differences in how altruism was measured. Corrêa's study utilized a self-report measure of altruism, where participants reported their engagement in altruistic behaviors, some of which did not involve monetary aspects. In contrast, Weissberger's study employed a behavioral economics paradigm with real monetary outcomes to assess altruism. Methodological variations may explain the discrepancies observed in the findings across studies.

1.5.2.3. Altruism and brain structure.

Neuroscientific studies (see figure 8) have identified specific patterns of brain activity associated with altruism. The inclination to engage in altruistic decision-making and behaviors involves regions within the mentalizing networks such as the medial prefrontal cortex (mPFC) and temporoparietal junction (TPJ), as well as areas associated with reward such as the ventral tegmental area (VTA), striatum, specifically the nucleus accumbens (NaCC), and anterior cingulate cortex (ACC), and regions of the emotional salience network including the dorsolateral prefrontal cortex (DLPFC), insula, and amygdala (Filkowski et al., 2016)

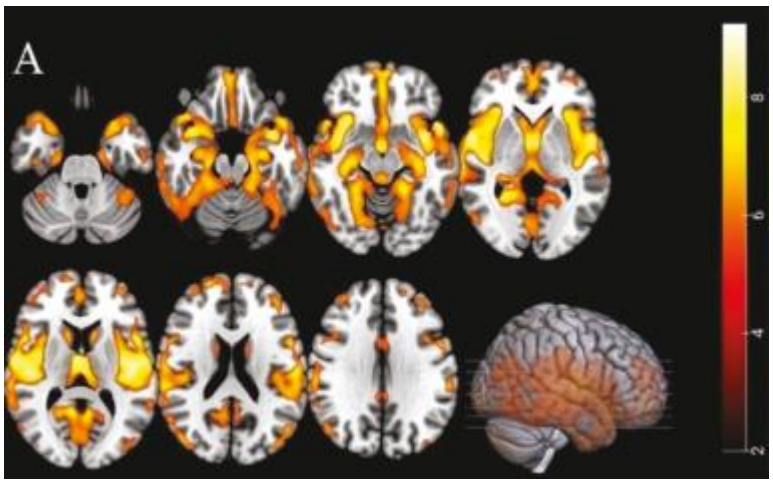
Figure 8: Schematic representation of brain networks associated with reward (green), mentalizing and theory of mind (pink), and emotional salience (blue) thought to be involved in altruistic behavior.



Moreover, A study was conducted by Liu et al. (2022) on a large group of older adults living in the community to explore the relationship between altruistic social activity, depressive symptoms, and the volume of gray matter in various brain regions. The findings suggest that participating in altruistic social activities is associated with larger volumes of gray matter in several brain regions, including the posterior insula, middle cingulate gyrus, hippocampus, superior temporal gyrus, thalamus, and middle

occipital gyrus, anterior orbital gyrus. Interestingly, these activities could potentially help reduce depressive symptoms in older adults, indicating a possible mediating effect of these symptoms on the relationship between altruistic social activity and gray matter volume (see Figure 9).

Figure 9: Greater gray matter volume related to altruistic social activity.



1.5.2.4. Psychological Well-being and Life Satisfaction.

The examination of prosocial behavior, particularly altruism, in older adults has been a focal point in this section. Greenfield and Marks (2004) demonstrated that older adults engaged in formal volunteering roles tend to experience more positive affect, reduced negative feelings, and an enhanced sense of purpose in life compared to non-volunteers. Similarly, Kahana et al. (2013) found that altruistic attitudes play a distinct role in maintaining life satisfaction and positive affect in older adults. However, the relationship between the quantity of volunteering and its effects on well-being remains contentious. Some scholars suggest that individual factors such as education, income, and

altruistic tendencies influence the positive outcomes of volunteering, while excessive volunteering may lead to adverse consequences. For instance, Bjälkebring et al. (2021) found that increased altruism is psychologically beneficial for many older adults, but higher levels of volunteering were paradoxically associated with a decrease in life satisfaction. In summary, while there is a positive correlation between altruism and well-being, heightened altruism can also yield unintended consequences.

1.5.2.5. Prosocial behavior and altruism in normal vs. pathological aging

Seelig and Rosof (2001) meticulously differentiated between two forms of altruism: healthy and pathological. They proposed a comprehensive classification system, arguing that mature and healthy altruism, which they define as the ability to derive consistent and relatively conflict-free joy from contributing to others' well-being, is distinct from pathological altruism, which they describe as a compulsion to self-sacrifice for others' benefit. They contend that individuals exhibiting healthy altruism can satisfy their needs directly, manage their emotions, and derive pleasure from promoting others' welfare.

In older adults, healthy altruism is linked with numerous beneficial outcomes. As mentioned before Altruistic attitudes and actions, such as volunteering, have been shown to boost life satisfaction and positive emotions in later life. This is because these attitudes embody a spirit of generosity, irrespective of the older adult's capacity to provide tangible assistance to others (Kahana et al., 2013). Furthermore, recent findings suggest that higher levels of altruism are significantly correlated with improved cognitive performance (Lucchetti et al., 2023). These altruistic behaviors can vary from daily acts of kindness to

life-altering gestures. They often stem from a personal sense of compassion or obligation and are driven by positive moral rewards, a sense of fulfillment and joy, and external factors (Kartali G, et al. 2020). On the other hand, Pathological altruism is a multifaceted concept that delves into the intricate dynamics of altruistic behavior. It underscores scenarios where acts of kindness, intended to benefit others, inadvertently lead to negative consequences for the individual or others involved (Kaufman & Jauk, 2020). This phenomenon is complex, with good intentions sometimes leading to unexpected adverse outcomes. Essentially, it encompasses situations where efforts to enhance another's welfare result in foreseeable harm, as noted by third parties. This behavior is often driven by a conscious or subconscious desire to assist others, but it leads to results that contradict the initial intention, often harming both parties involved (Oakley, 2013). Regarding older adults, studies highlight changes in altruistic tendencies over time. They propose that as individuals age, they may exhibit a stronger sense of altruism and genuine concern for others compared to their younger selves (Hubbard et al., 2016). However, if this altruism becomes pathological, it risks eliciting negative effects. Pathological altruism in older adults can be linked with maladaptive psychological conditions, such as vulnerable narcissism, and concealed selfish motives hidden within acts of assistance (Kaufman & Jauk, 2020). "Interestingly, the concept of "healthy selfishness" emerges as a counterpoint to pathological altruism. Healthy selfishness encourages a balanced regard for one's well-being, development, and happiness, recognizing its potential to produce positive outcomes for both the individual and others"

1.5.2.6. Issues of prosociality

Recent research has shed light on the complexities of prosocial behavior and financial decision-making among older adults, highlighting both benefits and risks associated with these behaviors. Studies by Wiesberger et al. (2022) and Burnes et al. (2017) emphasize the potential negative consequences of excessive prosociality, such as burnout and exploitation, while also noting the decline in financial decision-making abilities with age.

Altruism is an economic preference that plays an important role in financial decision-making (Sparrow & Spaniol, 2016) and that have a dark side. In certain situations, it may lead to negative outcomes for those engaging in such behavior, as others may exploit their altruism for personal gain.it was found that older adults' prosocial behavior is influenced by the content of social information about a recipient. They tend to be more prosocial when the recipient is described with positive psychological and physical features (Rossi et al. 2019). This could potentially lead to exploitation if unscrupulous individuals manipulate these tendencies. One of the risks that older adults face in their prosocial behavior is the age-related reduction in reasoning ability. This reduction could impair their decision-making process, making them more susceptible to scams or financial exploitation (Rieger & Mata, 2013) Furthermore, their increased prosocial behavior could lead to over-commitment or burnout, especially if they are involved in formal volunteering activities (Bailey et al. 2021).

Frazier et al. (2021) find that oxytocin modulates neural activity in response to breaches of trust among older adults, indicating potential mechanisms underlying trust-related decision-making processes, for example, has been implicated in the formation and

maintenance of social bonds and in orchestrating altruism and associated prosocial behaviors (Marsh et al., 2020). Spreng et al. (2021) explore the vulnerability of older adults to financial exploitation, attributing it to age-related changes in cognitive, socio-emotional, and neural processes. Ebner et al. (2017) identify cognitive impairments and diminished positive affect as factors contributing to susceptibility to online fraud among aging individuals, underscoring the need for tailored interventions targeting cognitive and affective functioning. In the context of pathological aging, such as Alzheimer's disease, cognitive decline may impact prosocial behavior. Some studies suggest that cognitive decline can weaken deliberative processes that inhibit automatic and intuitive prosocial responses, leading to increased financial altruism (Mayr & Freund, 2020). “Overall, these findings Showed the importance of understanding the vulnerabilities of elderly people in financial decision-making and social interactions to mitigate risks of exploitation and fraud”

1.6. Social Vulnerability in Older Adults

They are complex factors that make older adults more prone to face health challenges. Financial instability, feelings of isolation, and limited social connection all play a part in impacting their overall well-being and make them socially vulnerable (Berkman et al., 2000; Cornwell & Waite, 2009) Social vulnerability as defined in studies by Andrew et Rockwood (2010) & Andrew (2010) is the extent to which an individual’s broader social circumstances expose them to health issues encompassing physical, mental, psychological and functional challenges. It becomes hard for older adults to access essential resources cope with difficulties and deal with various issues that come with aging when there is a lack of strong social ties (Bassuk et al.; 1999).

The concept of social vulnerability includes various factors that affect an individual's susceptibility to harm or negative outcomes within a social context. It is closely related to credulity and gullibility, which are both aspects of social intelligence, A personal trait that can lead to exploitation is a tendency towards credulity and gullibility (Greenspan, 2005; Greenspan et al., 2001; Greenspan & Stone, 2002). Credulity refers to the tendency to believe improbable propositions or information without sufficient evidence. In other words, credulous individuals are inclined to accept claims or ideas even when these lack empirical support, demonstrating a lack of critical skepticism and a readiness to take information at face value (Greenspan, 2005). Conversely, gullibility is closely related to credulity but specifically pertains to a person's susceptibility to being easily deceived or manipulated into making poor decisions. Gullible individuals are more likely to fall for scams, hoaxes, or deceptive tactics because they trust others too readily. The term "gullibility" is often used to describe a deficit in social intelligence, where an individual fails to distinguish between genuine information and deceptive or misleading claims. Importantly, gullibility is not confined to any particular group; under certain circumstances, anyone can display gullible behavior (Greenspan et al., 2001).

Multidimensional vulnerability, a concept provides a comprehensive view of the various obstacles and constraints experienced by the elderly in various aspects of their lives as decrease of Life satisfaction and social support (Cihlar et al., 2022). In this context life satisfaction relates to low financial capacities, poor health, social isolation that are typically considered as threats and potential stress factors that may lead to adverse outcomes in life (Grundy, 2006) These factors can unfold an enormous negative impact on the perceived quality of life in old age (Schröder-Butterfill & Marianti, 2006) These understanding aids in gaining a deeper insight into their circumstances and requirements. In

the context of social vulnerability, social support serves as an external protective factor that helps mitigate the effects of stressful events, particularly in older age (Moreno & Peralta, 2021). Research by Cihlar et al., (2022). discovered a significant correlation between multidimensional vulnerability, defined by the scarcity of personal resources across various life sectors, and a substantial reduction in overall contentment with life among the elderly. It was observed that social support acts as a protective factor against the adverse impact of multidimensional vulnerability on life satisfaction and the role of social support becomes increasingly crucial as the level of vulnerability escalates.

1.6.1. Social Factors and Health

1.6.1.1. Socio-economic Status

Various social elements as Socio-economic status (SES) such as lack of resources, support systems, isolation, community exclusion, interpersonal connections participation in social activities, personal efficacy, perceived control over life situations, and unity can impact older individuals (Andrew et Rockwood, 2010) Socioeconomic status (SES), comprising factors like occupation, income, and educational attainment, plays a pivotal role in influencing the health of older adults (Grundy, 2001). For instance, lower SES is a predictor of cognitive decline (Gale et al., 2012) and frailty (Woo et al., 2005).Moreover, Financial insecurity, adds another layer, which is characterized by inadequate financial resources and retirement income making older adults more vulnerable socially and impact their capacity to finance healthcare and sustain a satisfactory quality life (Mutchler & Burr, 1991) Research findings, for instance, involving community-dwelling Finnish older adults, subjective income sufficiency was found to be significantly associated with self-rated health (Sulander et al., 2012) social disengagement is linked to greater cognitive decline (Bassuk et al., 1999) enhanced disabilities (De Leon et al., 2003) and increased

risk of dementia (Fratiglioni et al., 2000). Recent study by De Castro Ferreira et al., (2022) found the welfare of the elderly is impacted by their social vulnerability, taking into account their socioeconomic and demographic characteristics. Elderly individuals residing in areas with medium to high social vulnerability witnessed a reduction in their social interactions and sensory capabilities. Moreover, those in areas with moderate vulnerability also experienced a deterioration in their physical health and activities associated with their past, present, and future (De Castro Ferreira et al., 2022)

1.6.1.2. Social Capital

Social capital plays an important role in influencing health outcomes that represent characteristics of the connection between individuals and communities (Coleman, J. S. 1988). it is defined also as the features in each one's community that make individuals more productive, enhance the level of trust and engagement (Putnam.,1996) enhance volunteerism (Kawachi et al., 1997) and reduce mortality rates (Lochner et al., 2003) in context of older adults, strong social capital encompassing participation in group activities and trust in others correlates with enhanced functional levels and improved self-assessed health (Andrew, 2005) social capital is emphasized for its potential to shape community well-being and health outcomes (Baum, 2000)

1.6.1.3. Educational Attainment and Income

The connection between educational attainment, income, and social vulnerability in the aging population has been a focal point in empirical research. Ross and Mirowsky's seminal work (2017) elucidate the significant impact of education on health, emphasizing that higher educational levels serve as a protective factor against social vulnerabilities encountered in old age. Additionally, Cutler and Lleras-Muney's comprehensive study

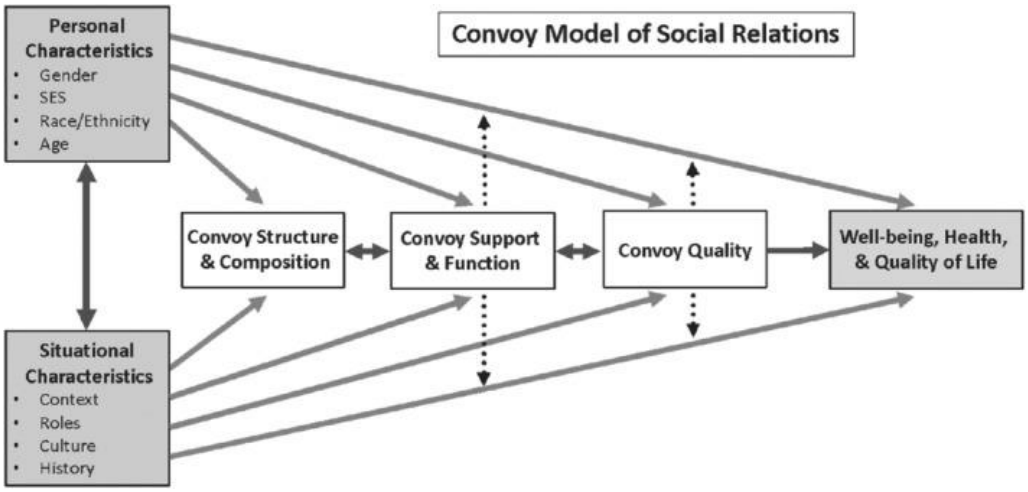
(2010) underscores the nuanced relationship between education, income, and health behaviors, shedding light on the pathways through which educational attainment and financial resources collectively influence overall well-being in later life. “These academic inquiries collectively highlight the multifaceted nature of the association between education, income, and social vulnerability in older adults, providing a robust foundation for understanding and addressing the complexities of aging in contemporary societies”

1.6.1.4. Loneliness and Isolation

Loneliness and social isolation profoundly affect the well-being of older adults, posing complex challenges across various aspects of their lives. Research has shown that loneliness can significantly impact the mental health and cognitive abilities of the elderly (Perissinotto et al., 2012; Donovan et al., 2016). Think of an older person navigating the challenges of aging while feeling the effects of loneliness. According to the social cognitive theory of aging, these individuals, shaped by a lifetime of social interactions, face declining self-efficacy and increased susceptibility to social vulnerability as their social connections diminish (Charles, 2010). Shankar et al. (2011) highlights that isolation isn't just a psychological issue but a tangible threat to the health and longevity of older adults. Loneliness contributes to higher morbidity and mortality rates, making those who are already vulnerable even more so. The social convoy model (see figure 10) emphasizes the importance of social relationships, both emotional and instrumental, in navigating the aging process (Antonucci, 2001; Kahn & Antonucci, 1980). Loneliness disrupts these networks, leaving older adults to face challenges without the support of a strong community (Antonucci et al., 2017). Understanding the connection between loneliness, social isolation, and social vulnerability is crucial for developing interventions to improve the well-being of older adults. Social isolation and loneliness are significant contributors to

health problems and mortality rates, similar in impact to well-known risk factors like smoking, alcohol use, obesity, and frailty (Freedman & Nicolle, 2020).

Figure 10: Convoy Model adapted by Antonucci, 2001; Kahn & Antonucci, 1980.



1.7. Financial Exploitation Risk

Financial exploitation targeting older adults presents a multifaceted challenge, exacerbated by underreporting, as emphasized by Jackson and Hafemeister (2011). This issue is prevalent due to the accumulated wealth and retirement savings of older adults, making them prime targets for scams and fraud. Research indicates a prevalence rate of 2.7% to 4.7% for financial exploitation, with various forms such as unauthorized bank withdrawals and loan fraud resulting in significant average losses per case (Department of Aging, s. d. 2020). Psychological factors and social isolation amplify susceptibility, with a considerable portion of cases perpetrated by close contacts (Peterson et al., 2014). Moreover, comorbid cognitive decline, dementia, and depression further exacerbate vulnerability (Wood & Lichtenberg, 2016). Weissberger et al. (2019) establishes a link

between perceived financial exploitation and adverse mental and physical health outcomes among cognitively intact older adults, demonstrating heightened depressive symptoms and anxiety levels. The negative impact extends broadly, affecting the quality of life psychologically, emotionally, and financially (Beaulieu et al., 2015; DeLiema, 2017). For victims, financial exploitation correlates with increased rates of hospitalization, long-term care admissions, and mortality (Button et al., 2012; Dong et Simon, 2013). This underscores the urgent need for intervention and support mechanisms to safeguard older adults against financial exploitation and its devastating consequences.

1.8. Fraud and Scam in Older Adults

Fraud emerges as a prevalent and significant threat to older adults, with millions falling victim to various schemes annually, resulting in substantial financial losses (Federal Trade Commission, 2013). Boyle et al. (2019) found that a significant percentage of older adults are susceptible to telemarketing scams, highlighting the need for awareness and protection. The distress caused by victimization can lead to severe physical and mental health issues, including depression, anxiety, and functional somatic complaints (Button et al., 2014; Ganzini et al., 1990). Shadel et al. (2021) emphasize heightened emotional arousal and stress as contributors to older individuals' vulnerability to scams, despite their significant household wealth. The aftermath of fraud often brings feelings of self-blame and embarrassment, further impacting psychological well-being (DeLiema et al., 2017). Moreover, technological advancements have introduced new avenues for financial exploitation, such as phishing, which poses a significant threat in the online realm (IC3 Internet Crime Report, 2014, 2019).

1.8.1. Prevalence

Anderson (2013) reports varying rates of consumer fraud victimization among different age groups in the United States: 9.1% for individuals aged 55 to 64, 7.3% for those aged 65 to 74, and 6.5% for individuals over 75. Similarly, data from the UK's Crime Survey for England and Wales (CSEW) estimates a 4.0% victimization rate among individuals aged 75 and older (Office for National Statistics, 2016). Burnes et al. (2017) conducted a meta-analysis revealing a 5.6% prevalence of elder financial fraud among community-dwelling and cognitively intact older adults. Moreover, Fenton et al. (2022) found a similar 5.6% prevalence of financial fraud among older adults living in the community, indicating that roughly one in 18 individuals falls victim annually. Despite these findings, obtaining precise estimates remains elusive due to underreporting and awareness issues (Ross et al., 2014).

1.8.2. Emotional regulation and motivation framework

The vulnerability of older adults to fraud can be elucidated through the socio-emotional selectivity theory, asserting that aging individuals perceive a diminishing future time, leading to a reprioritization of social goals (Mather & Carstensen, 2005). This shift involves transitioning from knowledge-related objectives to those with emotional significance, accompanied by an augmented focus on positive emotional information (Carstensen & Mikels, 2005). Notably, the recognition of limited future time prompts older individuals to avoid negative emotional experiences and accentuate attention towards positive aspects, termed the "positivity effect" in aging (Carstensen, 2006; Mather & Carstensen, 2005). According to these research findings, studies show that older individuals tend to focus more on positive or neutral information rather than

negative information. Additionally, their memory recall is more precise for positive stimuli compared to negative emotional stimuli (Mather & Carstensen, 2003). This psychological inclination contributes to the heightened susceptibility of older adults to fraudulent activities.

1.8.3. Susceptibility to Scams in Older Adults Without Dementia

Research by James et al. (2014) involving 639 older adults residing in the community, all free from dementia, found that patients who exhibited lower levels of cognitive function, lower levels of psychological well-being, less social support, and facing challenges in health and financial literacy, displayed heightened susceptibility to scams. This vulnerability remained significant even after accounting for variations in education and income levels. “The study further exhibits that susceptibility to scams demonstrated a positive association with age while displaying a negative correlation with income, cognitive abilities, social support, psychological well-being, and literacy”. It's worth noting that older adults are more vulnerable to scams compared to younger individuals, even when accounting for variations in socioeconomic status, cognitive health, and literacy. These results indicate that even among people with old age without dementia, cognitive function plays a role in determining who is susceptible to scams.

Additionally, older adults often experience declines in financial literacy and decision-making capacity, making them more prone to manipulation in complex financial transactions (Lusardi & Mitchell, 2011) Social factors, including increased isolation and a lack of familiarity with modern technology, further contribute to their susceptibility (Burnes et al., 2017)

In addition, Poor decision-making is a consequence of cognitive decline among older persons without Alzheimer's disease or mild cognitive impairment, Evidence suggests that older adults even those without dementia, often make poor decisions and are selectively vulnerable to scams, this is supported by a study of 420 persons without dementia, more rapid cognitive decline predicted poorer decision-making and increased susceptibility to scams The relations between cognitive decline, decision-making, and scams persisted in analyses restricted to persons without any cognitive decline or even mild cognitive impairment (Boyle et al., 2012) furthermore, The decline in working memory among older adults with age, as indicated by research (Mather, 2006; Yoon 2009), may lead to a reduced capacity for information processing compared to younger adults. Consequently, older individuals are inclined to search for less information and, instead, rely on simpler or heuristic strategies when making decisions, these decision-making strategies may include the use of non-compensatory strategies potentially making it challenging for older adults to effectively identify deceptive sales practices (Mata et al., 2010).

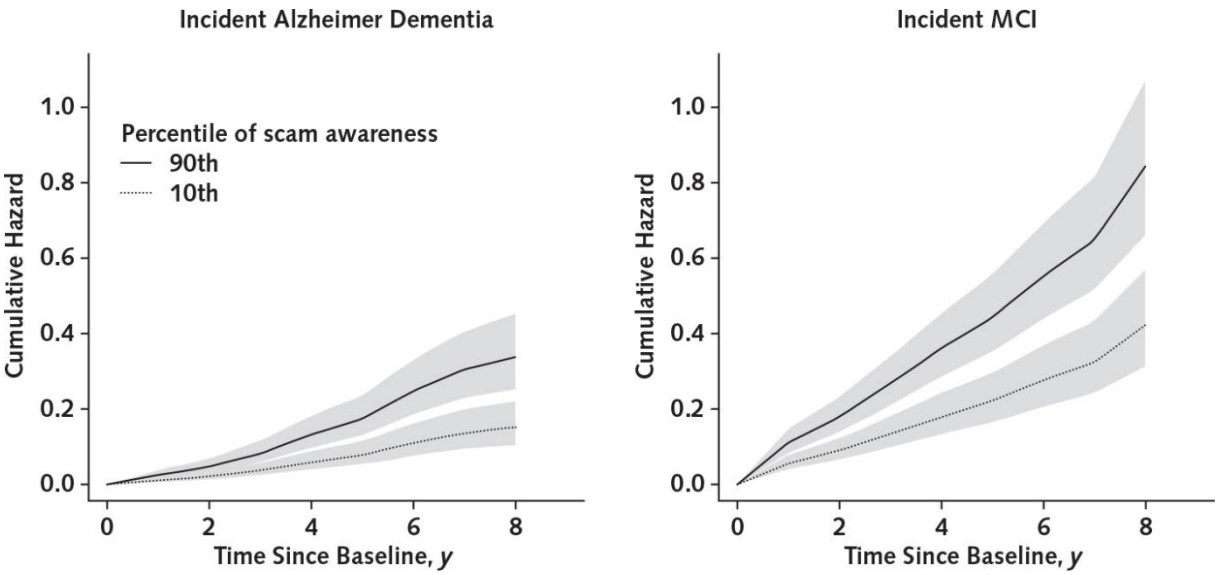
Cognitive decline or mild cognitive impairment may put older adults at greater risk for financial exploitation or susceptibility to scams. The Theory of Mind, Executive Functioning, and Adaptive Functioning are important cognitive systems that may contribute to the increased vulnerability of older adults to scams. Understanding these cognitive systems and their decline can help identify strategies to reduce the risk of scams in older adults with mild cognitive impairment and dementia (Sergeyev et al., 2023) Elderly individuals who possess a greater understanding of financial principles and the inner workings of financial and healthcare institutions may exhibit a reduced susceptibility to falling prey to deceptive information propagated by scammers,

irrespective of their cognitive capabilities. (James et al., 2014). Factors like cognitive health, psychological well-being, and financial literacy have been recognized as related to the susceptibility of older adults to scams (Yu et al., 2021).

1.8.4. Susceptibility to Scams in Older Adults with MCI and Dementia

Susceptibility to scams in older adults with dementia or mild cognitive impairment is a significant concern. Boyle et al. (2019) conducted a study indicating that diminished scam awareness could serve as an early sign of Alzheimer's dementia and mild cognitive impairment MCI (see figure 11) The research revealed a connection between low scam awareness and an elevated risk of developing these conditions. Low scam awareness was associated with a lower education level, old age, and also lower global cognition ($P < 0.001$) at baseline. Furthermore, the study linked reduced scam awareness to a higher presence of Alzheimer's pathology in the brain, particularly beta-amyloid. This suggests that impaired scam awareness might be an early indication of pathological cognitive aging and a predictor of adverse cognitive outcomes in older adults with dementia or MCI.

Figure 11: Cumulative hazards of developing Alzheimer dementia or MCI for representative women with high versus low scam awareness scores, with 95% confidence bands.



Note: Representative women have an average age and average years of education. High scores reflect low awareness (90th percentile), while low scores signify high awareness (10th percentile). MCI stands for mild cognitive impairment.

As research has shown that cognitive impairment can lead to a greater vulnerability to fraudulent activities. Adults with mild cognitive impairment (MCI) might be more vulnerable to scams compared to those with normal cognitive function, as they often have reduced abilities in particular cognitive areas, such as perceptual speed and episodic memory. contributing to this susceptibility (Han, Boyle, James, Yu, & Bennett, 2015) A study found that approximately 1 in 18 cognitively intact older adults in the US falls victim to financial fraud and scams each year, and the number is thought to be much higher when considering individuals with cognitive impairment (Yu et al., 2023) Additionally, a study found that cognitive decline is a strong risk factor for scam

vulnerability in older adults, including those with MCI, mild Alzheimer's disease, and vascular dementia (Ueno et al., 2021)

1.8.5. Loneliness and Susceptibility to Scams in Older Adults

Loneliness is characterized by the sensation of being alone or detached from others, distinct from the concept of social isolation, which involves physical separation from or lack of relationships with others (de Jong Gierveld et al., 2006). Existing research indicates a link between social isolation and susceptibility to scams in older adults, suggesting that individuals with restricted social relationships are more prone to falling victim to scams (Consumer Fraud Research, 2006) Loneliness, a widespread experience among older individuals and a significant challenge in their later years (Chen & Schulz, 2016) is recognized as a potent psychosocial factor that increases the vulnerability of older adults to Fraud (Alves & Wilson, 2008; Shao et al., 2019). Remarkably, Cognitive decline and other factors contribute to this susceptibility. notably, older adults, driven by a strong desire for emotional connection and grappling with loneliness, can be easily exploited in various ways, such as through deceptive practices under the guise of "emotional care" (jing, 2022). Seeking substitutes for their lack of social connection, they may inadvertently expose themselves to situations where the risk of falling victim to fraud is heightened (Tong et al., 2020). Fees et al. (1999) found the more older adults experience loneliness the more they are vulnerable to fraud. Similarly, Jing et al. (2022) Found that loneliness is a positive predictor of susceptibility to persuasion only in older adults with low levels of self-control.

1.8.6. Education and Susceptibility to Scams in Older Adults

Financial vulnerability remains a concern for older adults, making them more susceptible to scams and fraud. Understanding the connection between financial fragility and scam vulnerability in this age group is still a puzzle. Recent research by Yu et al. (2022) points to an interesting pattern: financially vulnerable older adults tend to have lower educational levels, indicating a clear link between limited education and increased financial vulnerability, Moreover, a study conducted by Glover et al. (2022), researchers explored the relationship between cognitive function and susceptibility to scams in older adults. After adjusting for age and gender, they found a significant association—lower cognitive function is linked to a higher susceptibility to scams. What's noteworthy is that education plays a role in this connection. Together, these findings emphasize the complex dynamics involving financial vulnerability, education, and cognitive function that contribute to the vulnerability of older adults to scams.

Chapter 2 – The research

2. The Research

With the aging population, it's vital to understand how cognitive decline affects social vulnerability. While altruism improves older adults' mental well-being and satisfaction, it can also increase risks like exploitation, especially in those with cognitive issues such as Mild Cognitive Impairment (MCI). Cognitive decline affects decision-making and raises the risk of scams, but how altruism interacts with cognitive impairment to influence scam susceptibility is not well-studied. There is a notable gap in research regarding how the combination of altruism and cognitive status impacts vulnerability to scams, and how different contexts might affect this relationship. This study seeks to fill these gaps by exploring the connections between altruistic behavior, cognitive impairment, and susceptibility to scams among elderly individuals.

2.1. Primary objective and hypothesis

The general objective of the study:

The overall objective of the study is to evaluate the relationship between altruistic behavior, social vulnerability, and susceptibility to scams in elderly subjects without cognitive impairment and with cognitive impairment. In which The primary objective is to test the hypothesis that high levels of altruism (as measured by the ECRC Altruistic Scale) are associated with increased susceptibility to scams (as measured by the Susceptibility to Scam Scale) in the elderly, particularly those with cognitive impairment.

Secondary objectives :

1. Assess differences between elderly with and without cognitive impairment in altruistic behavior;

2. Assess differences between elderly with and without cognitive impairment in social vulnerability;
3. Assess differences between elderly with and without cognitive impairment in susceptibility to scams;
4. assess differences between elderly with and without cognitive impairment in real-life experiences of scams;
5. assess the relationship between cognitive ability, social vulnerability, susceptibility to scams and altruistic behavior in the elderly with and without cognitive impairment;
6. assess the relationship between cognitive reserve, social vulnerability, susceptibility to scams and altruistic behavior in the elderly with and without cognitive impairment.

2.2. Material and Methods:

2.2.1. Participants:

A total of 119 participants **(Mage= 75.54; SD = 7.38; age range: 60-97)** were enrolled in this prospective, cross-sectional study. The inclusion criteria were >64 years and more than >5 years of education. Participants included 61 older adults diagnosed with Mild cognitive impairment (MCI group) and 58 with Normal cognitive functioning (NCF group). Participants in the MCI group were recruited from the Neurological Institute IRCCS Mondino Foundation, while the normal cognitive functioning group was recruited

from the general population. Mild Neurocognitive Disorder diagnoses were classified according to criteria of the DSM- 5 (American Psychiatric Association, 2013). The diagnosis was reached through a multidisciplinary screening that included physical, neurological and neuroradiological examination, neuropsychological testing, and assessment of daily living activities. MCI diagnosis was based on preservation of functional ability in daily life, subjective report of cognitive impairment, and objective cognitive impairment. The normal cognitive functioning group was free of any reported functional difficulties or subjective and objective cognitive impairment. See Table 1 for sample characteristics. This study was completed in accordance with the Helsinki Declaration and approved by the Pavia Ethical Committee (reference number: P-0008605/23). Informed consent was obtained from all subjects involved in the study.

2.2.2. Measures:

Altruism scale:

The Elderly Care Research Center (ECRC) Altruistic Scale, a specialized instrument developed by Bhatta et al., is utilized to gauge altruistic tendencies and perspectives. This tool is particularly focused on the elderly population, recognizing the importance of altruistic attitudes to health and their role in promoting psychological well-being. The scale consists of 5 items: “I enjoy doing things for others,” “I try to help others, even if they do not help me, (“Seeing others prosper makes me happy,” “I really care about the needs of other people,” and “I come first and should not have to care so much for others.” These items are measured on a 5-point Likert scale, with 1 being ‘strongly disagree’ and 5 being ‘strongly agree’. The ECRC Altruistic Scale has demonstrated robust correlations with key personality traits, psychological well-being, religiousness, and life’s meaning. This

reinforces its construct validity and allows for an in-depth analysis of the impact of altruism on health and well-being in later life. The existence of this reliable and valid tool enables a comprehensive evaluation of altruism's influence on later-life health and well-being (Bhatta et al., 2020).

Donation task:

The donation task is administered in order to evaluate current altruistic behavior. The task consists of asking the subject to imagine having participated in a competition and having won 100 euros. The subject has the possibility of donating the money to the person he sees in the photo, representing a young adult. The task presents two conditions: in the control condition the subject is not provided with any type of information on the recipient of the photo, in the experimental condition it is described that the recipient of the photo is a person who has low economic resources. The amount of money donated from 0 to 100 is the index of altruistic behavior.

Social Vulnerability Scale (Pinsker et al., 2011)

The Social Vulnerability Scale, a validated tool established by Pinsker et al. (2011), is designed to gauge the level of social vulnerability in individuals. It evaluates various aspects such as social support, economic stability, resource accessibility, and crisis coping mechanisms. The goal is to pinpoint those who might be more prone to adverse outcomes due to their social vulnerabilities. This scale, which consists of 22 items, serves as an informant report that quantifies the susceptibility to exploitation, including financial exploitation, particularly in older adults. It has been validated and found to have a moderate correlation with emotional and behavioral issues. The scoring system is based on a 5-point Likert-type scale that reflects the frequency of the behavior of interest. The

scale ranges from 0 (never) to 4 (always). Consequently, a higher score signifies a higher degree of social vulnerability, with the total score ranging from 0 to 88 (Pinsker et al., 2011)

Susceptibility to Scam Scale (James et al., 2014)

The Susceptibility to Scam Scale, formulated by James et al. (2014), is a psychometric instrument crafted to assess the likelihood of individuals becoming victims of scams. It includes items that evaluate cognitive elements such as gullibility, trustworthiness of others, and decision-making skills in uncertain situations. This scale is instrumental in determining the participants' vulnerability to manipulation and deceit in diverse settings. This scale is a self-report measure consisting of five items that assess the level of agreement with statements pertaining to behaviors of telemarketers, con artists, and dubious claims. Participants express their agreement on a 7-point Likert scale (ranging from strongly agree to strongly disagree) with the following statements:

1. I pick up the phone every time it rings, regardless of whether I recognize the caller.
2. I find it hard to hang up a phone call, even if the caller is a telemarketer, someone unknown, or someone I didn't want to call me.
1. 3.If something appears too good to be true, it usually is.
3. Individuals over the age of 65 are frequently targeted by con artists.
4. If a telemarketer calls me, I typically pay attention to what they have to say.

The overall score is the mean of the ratings across all five items (with items 1, 2, and 5 reverse coded so that higher scores indicate a greater susceptibility to scams for all items). (James et al., 2014)

Scams Questionnaire (Teunisse et al., 2020)

The Scams Questionnaire, developed by Teunisse et al. in 2020, is a 12-item self-report measure. is a tool designed to evaluate an individual's susceptibility to various scams. This self-report measure focuses on gullibility, an enduring personality trait that may increase an individual's vulnerability to scams. The questionnaire includes items related to previous scam encounters, awareness of common scam strategies, and behavioral responses to scam attempts. The primary objective of this questionnaire is to understand the likelihood of participants falling victim to fraudulent schemes. It serves as a reliable and valid instrument for measuring gullibility (Teunisse et al., 2019)

Neuropsychological batteries:

MMSE:

The Mini-Mental State Examination (MMSE; Folstein et al., 1975) is a screening test widely used to assess global cognitive functioning. It comprises a series of items to measure temporal and spatial orientation, immediate and delayed memory, language, attention, and visual construction. The total score, ranging from 0 to 30, is calculated by summing all correct items. The Mini-Mental State Examination (MMSE), is a common method for evaluating cognitive abilities, especially in older adults and individuals suspected of cognitive disorders like dementia. The MMSE is designed for quick and easy administration, typically taking between 5 to 10 minutes to complete. It comprises a variety of tasks and questions that assess cognitive functions across five key areas: orientation, registration, attention and calculation, recall, and language.

A of 30 items exploring:

- Orientation to time and place: The individual's awareness of the current date, location, and situation.
- Attention and concentration: The person's capacity to focus on specific tasks or instructions.
- Short-term memory (recall): The individual's ability to remember a short list of items after a short interval.
- Language skills: The person's comprehension and usage of language, which includes naming objects, following commands, and the ability to read, write, and repeat sentences.
- Visuospatial abilities: The individual's understanding of the visual and spatial relationships between objects, demonstrated through tasks like replicating a drawing.

The MMSE is scored on a scale of 30 points, with a score of 25 or above generally considered within the normal cognitive range. Scores below 24 suggest potential cognitive impairment, with lower scores indicating more severe levels of impairment (Folstein et al., 1975)

Raven 47:

The Raven's Coloured Progressive Matrices (RCPM) is a cognitive assessment tool that was developed by John C. Raven in 1947. This tool, which is non-verbal in nature, is designed to gauge abstract reasoning and is seen as a non-verbal measure of fluid intelligence. It is particularly useful for assessing children between the ages of 5 and 11, the elderly, and individuals with physical and mental impairments. It is also used with

typical and clinical populations, including those with intellectual disabilities. The RCPM is a part of the larger Raven's Progressive Matrices and includes three forms that increase in difficulty: A, AB, and B. Each form contains 12 items, making a total of 36 items across all three forms. The items on the test are visual geometric designs with a piece missing, and the test-taker must identify the correct piece that completes the pattern from several options. The items are displayed on a colored background to make the test visually appealing, but the colors do not play a role in solving the problems. Scoring on the RCPM is straightforward: one point is awarded for each correct answer, while incorrect answers receive no points. This means that the raw score on the test can range from 0 to 36 (Raven et al. 1998).

Digit span forward and background:

The Digit Span Forward and Backward test is a recognized tool for evaluating working memory and short-term verbal memory used in different assessment batteries (e.g., Petermann & Wechsler, 2008, A. S. Kaufman & Kaufman, 1983) In the forward variant, the test administrator recites a series of numbers, and the test taker is asked to repeat them in the order they were given. The series of numbers progressively gets longer, primarily testing the individual's short-term auditory memory. In the backward variant, the test taker is asked to repeat the numbers in the reverse order they were given. This version is seen as more demanding since it requires the test taker to mentally rearrange the information, rather than just memorizing it, assessing working memory. Regarding the scoring system, each span in the Digit Span Forward and Backward test is given a score of '1' (Pass) or '0' (Fail). The test is stopped when the test taker fails both trials of the same span length (for example, 5a and 5b). The results include the task direction (forward or backward), the longest sequence successfully completed, and the total number of

attempts. This is an oral task, with stimuli presented through hearing, and responses given verbally by the test taker.

Cognitive Reserve Index Questionnaire (CRIq) :

The Cognitive Reserve Index questionnaire (CRIq) is a tool that measures an individual's cognitive reserve, a concept that accounts for the differences in individuals' ability to tolerate brain pathology or age-related changes. This reserve is believed to be shaped by life experiences, including education, occupation, and leisure activities. The CRIq is composed of demographic data and items divided into three categories: education, work activity, and leisure time. Each category generates a sub-score, which collectively contributes to the overall evaluation of a person's cognitive reserve. This method offers a standardized way to quantify the cognitive reserve that individuals have built over their lifetime (Nucci et al., 2012).

Rey Auditory verbal learning test (RAVLT):

The Rey Auditory Verbal Learning Test (RAVLT) is a tool used in neuropsychology to measure different facets of verbal memory, such as immediate recall, delayed recall, and recognition memory. The test is beneficial for evaluating short-term memory, working memory, and long-term memory, and can offer insights into proactive inhibition, retroactive inhibition, retention, encoding versus retrieval, and subjective organization of verbal information The test employs a list-learning model where participants are given a list of 15 nouns (List A) and are tasked with remembering as many words as they can from this list. This procedure is usually repeated across several trials to gauge learning and memory skills. The RAVLT also incorporates an interference trial with a separate list of words (List B) to measure the impact of interference on memory recall. Following the

immediate recall tasks, there is a phase of delayed recall where participants are tasked with remembering words from List A after a certain period, typically around 20-30 minutes. Lastly, a recognition task may be conducted, where participants are required to identify which words were part of the original list from a larger set of words. The sum of the words recalled in the 5 trials constitutes the immediate recall score range from 0 to 75. The words recalled in the delayed test (after 15 minutes) constitute the score of the delayed test (range 0-15), (REY.A, 1958)

Frontal Assessment Battery (FAB):

The Frontal Assessment Battery (FAB) is a concise neuropsychological test originally developed by Partington (Brown & Partington,1942) aimed at evaluating the functions of the frontal lobe, which are essential for executive tasks like planning, problem-solving, and behavior regulation. It's a handy tool for diagnosing potential frontal lobe dysfunction, especially useful in differentiating frontotemporal dementia (FTD) from other dementias like early-stage Alzheimer's. The FAB comprises six subtests, each examining a different facet of executive functioning:

1. Conceptualization: Tasks like identifying object similarities to gauge the patient's ability to abstract concepts.
2. Mental Flexibility: Tasks like the S-word generation, where patients must generate words starting with a specific letter.
3. Motor Programming: Assessed through Luria's test involving a series of hand movements.
4. Sensitivity to Interference: Tested through conflicting instructions, requiring patients to respond differently to the examiner's actions.

5. Inhibitory Control: Assessed with the Go-No-Go test, measuring the patient's ability to control impulsive responses.

6. Environmental Autonomy: Includes assessing prehension behavior or grasp reflex, examining the patient's spontaneous tendency to adhere to environmental cues.

The total score is out of 18, with higher scores indicating better performance. A cutoff score of 12/18 can differentiate FTD from mild Alzheimer's with a sensitivity of 77% and specificity, with lower mean scores accepted as "normal" for those with fewer years of education.

Trial making test TMT A-B:

The Trail Making Test (TMT) is a cognitive evaluation instrument that measures a variety of mental capabilities such as attention, speed of processing, cognitive flexibility, visual search and scanning, sequencing, and executive functions. Trail Making Test (TMT) was originally developed by U.S. psychologists John E. Partington and Russell G. Leiter in 1938 (*APA Dictionary Of Psychology*, s. d.). It is especially adept at identifying cognitive deficits linked to advanced cognitive processes like planning, self-regulation, and memory creation. The TMT is divided into two sections, A and B, each of which is designed to evaluate different cognitive abilities. The Trail making Test part A (TMT A; Giovagnoli et al., 1996) consists of connecting, as quickly as possible, a series of numbers (1–25) randomly distributed on a sheet of paper. The total score is the total completion time of the test in seconds. We applied a transformation so that higher scores reflected better performance (i.e., the transformed score reflected 1/x, where x represents the score

obtained by the subject in the task). In studies involving multiple sessions, Cronbach's alpha generally falls within the .70 to .90 range (Giovagnoli et al., 1996).

Phonological fluency test:

The Verbal fluency test (Novelli et al., 1968) consists of two subtests: phonemic fluency and semantic fluency. **In the phonemic fluency task,** participants are asked to generate as many words as possible beginning with the letter "F", "A", and "S", allowing 60 s for each letter. In the semantic fluency task, participants are asked to generate as many words as possible falling in the categories "Fruits", "Animals", and "Cars". Proper names, places, and words with the same suffix do not receive credit. The score in each subtest is the sum of the correct words generated for each letter (i.e., phonemic fluency task; Cronbach's alpha = .89) and each category (i.e., semantic fluency task; Cronbach's alpha = .87).

2.2.3. Procedure

Participants provided written informed consent before beginning the neuropsychological assessment. They were tested individually during a single session that generally lasted 2 hours. The order of the test administration was the same for all subjects: participants completed neuropsychological testing (MMSE, CRIQ, RAVLT, SCWT, FAB, RAVN 47, TMTA, Phonemic Fluency, Semantic Fluency, Donation task, social vulnerability, susceptibility to scam, scam questionnaire, Digit span forward and backward, Phonological fluency test).

2.2.4. Statistical Analysis:

In this study, Statistical Package for the Social Sciences (SPSS) software was utilized to conduct a comprehensive statistical analysis of the collected data. Descriptive statistics,

including means, were employed to summarize and interpret the key variables of interest. Specifically, means were calculated to determine the average values of the variables under investigation.

The statistical analysis for this study will be conducted to address the primary and secondary objectives. For the primary objective, we will perform a Pearson correlation analysis to evaluate the relationship between altruistic behavior (measured by the ECRC Altruistic Scale) and susceptibility to scams (measured by the Susceptibility to Scam Scale). This analysis will be stratified to examine differences between elderly individuals with cognitive impairment and those without. The significance level for all tests will be set at 0.05.

For the secondary objectives, descriptive statistics will be used to summarize the study variables, including frequencies, means, medians, and standard deviations. Differences in categorical variables will be assessed using the Chi-square test, while differences in continuous variables will be analyzed using the t-test (for paired and independent samples) and ANOVA (both univariate and repeated measures). Pearson correlation will be utilized to examine relationships between variables. In cases where data do not meet the assumptions of normality, non-parametric tests, such as the Mann-Whitney U test or Kruskal-Wallis test, will be applied. All analyses will be performed using SPSS version 26.0, and the results will be interpreted in the context of the study's hypotheses and objectives.

2.2.5. Sample characteristics:

Table 1 summarizes the sample characteristics and reported statistic values. There were group differences in terms of age and years of education, where the MCI group were significantly older

[**F (1.117) = 8.09, P= 0.05]** and less educated **[F(1.117) = 9.57, P= 0.02]** Compared to the NCF group. There were also group differences in terms of gender. Male/female **50/69 Approximately 42.02%** males and **57.98% females.** In which we have less males in the healthy group compared to the pathological group and more females than males in the healthy group (**Q2 (1) = 3.98, p = .046)**

2.3. Results:

Preliminary analyses on MMSE, neuropsychological tests, and CRI between NCF, and MCI groups.

Table 1: Descriptive/one-way ANOVA of Age, Years of education, neuropsychological tests, CRI of school, work, free time, and total

	MCI (n=61)	**NCF (n=58)**	**SD**	**F (1,117)**	**P-value**
Age	77.36	73.62	7.383	8.088	.005
Years of education	9.43	11.95	4.359	9.571	.002
Gender Male/Female	31 / 30	19 / 39	3.981		.046
Neuropsychological tests					
MMSE (0-30)	24.69	28.08	2.899	61.733	.001
Digit span forward	5.14	6.14	.6151	54.647	.000
Digit span backward	4.03	4.75	.9777	16.583	.000
Rey_RI_c (0-75)	31.94	43.60	9.272	76.743	.000
Rey_RD_c (0-15)	5.05	9.30	3.66	59.265	.000
FAS_c	27.94	39.63	10.47	53.020	.000
TMTA_c	90.55	61.79	42.88	14.581	.000
TMTB_c	212.13	57.86	111.99	79.596	.000
RAVEN 47 (0-36)	25.89	31.26	11.44	6.756	.011
FAB_c (0-18)	12.43	16.64	3.42	71.253	.000
CRI_lavoro,tempo libero,totale					
CRI_school	106.84	113.14	16.74	4.479	.036
CRI_Work	101.44	107.07	23.22	1.756	.188
CRI_free time	108.39	109.91	23.18	.127	.722
CRI_Totale	107.39	113.31	21.47	2.282	.134

The NCF group demonstrated significantly superior performance compared to the MCI group across multiple cognitive domains. This was evident in the mean scores and associated p-values derived from various neuropsychological assessments, including the MMSE ($F(1.117)=61.7$, $p=.001$), Digit Span Forward ($F(1,117)=54.6$, $p=.000$), Digit Span Backward ($F(1,117)=16.5$, $p=.000$), Rey Auditory Verbal Learning Test Immediate Recall ($F(1,117)=76.7$, $p=.000$), Rey Auditory Verbal Learning Test Delayed Recall

(F(1,117)=59.2, p=.000), FAS Test (F(1,117)=54, p=.000), Trail Making Test Part A (F(1,117)=14.5, p=.000), Trail Making Test Part B (F(1,117)=79.5, p=.000), Raven's Progressive Matrices (F(1,117)=6.7, p=.011), and Frontal Assessment Battery (F(1.117)=71.2, p=.000). Conversely, no significant differences were observed between the two groups in cognitive reserve (CR) work (F(1,117)=4.47, p=.036), CR free time (F(1,117)=1.75, p=.188), or CR total (F(1,117)=0.12, p=.722). Notably, significant discrepancies were noted in CR related to schooling (F(1,117)=2.28, p=.134). Overall, these findings underscore marked distinctions in cognitive function between the two groups, with the NCF cohort consistently outperforming the MCI group across various cognitive metrics, all exhibiting p-values below .001.

Table 2: Oneway Donation_task_control Donation_task_experimental ECRC_Altruistic_Total SSS_total, SVS_guillability, SVS_credulity, SVS15_Total BY Group /STATISTIC descriptive

	MCI (=61)	NCF (58)	SD	F	P-value
Donation task-control	38.69	50.00	32.53	3.675	.058
Donation task experimental	51.31	65.86	32.15	6.365	.013
ECRC_Alturistic_total	18.14	18.39	2.99	.204	.653
SSS total	15.08	15.31	3.74	.110	.741
SVS_Guilibility	1.00	1.38	1.51	1.932	.198
SVS_Credulity	2.63	3.37	3.13	1.676	.198
SVS15_Totale (0-88)	3.60	4.70	3.91	2.347	.128

In the donation task control, older adults were not provided with descriptive profiles of younger recipients. They were endowed with 100 euros and tasked with dividing the sum among these recipients. In contrast, in the donation task experiment, older adults were primed with empathic concern. The statistical analysis revealed no significant disparities between the NCF group and the MCI group under the control condition (F(1,117)=3.67, p=.058). However, notable distinctions emerged between the two groups in the experimental donation task (F(1,117)=6.36, p=.013).

Moreover, there were no significant differences observed between the groups regarding ECRC Altruistic Total (F(1,117)=0.20, p=.653), SSS Total (F(1,117)=0.11, p=.741), SVS Guilibility (F(1,117)=1.93, p=.198), SVS Credulity (F(1,117)=1.67, p=.198), or SVS15 Total (F(1,117)=2.347, p=.128).

Table 3: Correlation of donation task experiment with all neuropsychological tests, ECRC-Alturistic totale, SSS Totale, SVS_Guilibility, SVS-Credulity, SVS15 Totale, past scam experience. (all sample)

Donation task experiment (all sample)		
	R (199)	**P-Value**
Age	-.120	.193
Years of education	.167	.069
MMSE	.187*	.042
Digit span forward	.057	.536
Digit span backgroud	.186	.056
Rey_RI_c	.051	.580
Rey_RD_c	-.035	.706
FAS_c	.096	.299
TMTA_c	-.112	.230
TMTB_c	-.120	.245
Martici_c	.072	.438
FAB_c	.092	.323
CRI_Totale	.227*	.013
ECRC_Alturistic_Totale	.111	.230
SSS_Total	-.054	.562
SVS_guilibility	.205*	.026
SVS_Credulity	.053	.571
SVS15_Totale	.111	.232
Past scam experience	.240**	.009

The findings revealed significant correlations between the donation task experimental condition and several variables: MMSE (r(119)=.187*, p=.042), CR total (r(119)=.227*, p=.013), SVS gullibility (r(119)=.205*, p=.026), and past scam experience (r(119)=.240**, p=.009). However, no significant correlations were observed between the donation task experimental condition and age (r(119)= -.120, p=.193), years of education (r(119)=.167, p=.069), Digit Span Forward (r(119)=.057, p=.563), Digit Span Backward (r(119)=.186, p=.056), Rey Auditory Verbal Learning Test Immediate Recall

(r(119)=.051, p=.580), Rey Auditory Verbal Learning Test Delayed Recall (r(119)= -.035, p=.706), FAS (r(119)=.096, p=.299), Trail Making Test Part A (r(119)= -.112, p=.230), Trail Making Test Part B (r(119)= -.120, p=.245), Raven's Progressive Matrices (r(119)=.072, p=.438), Frontal Assessment Battery (r(119)=.092, p=.323), ECRC Altruistic Total (r(119)=.111, p=.230), SSS Total (r(119)= -.054, p=.562), SVS Credulity (r(119)=.053, p=.571), or SVS15 Total (r(119)=.111, p=.232).

The correlation analyses were also conducted separately in the 2 groups healthy and MCI between the donation task experimental and all other variables.

Table 4: Correlation between Donation task in NCF group with neuropsychological tests, CRI total, ECRC Altruistic total, SSS Total, SVS Guilibility, SVS credulity, SVS15 Total, Past scam experience

Donation task Experimental (NCF)		
	R (58)	**P-value**
Age	-.041	.763
Years of education	.042	.752
MMSE	-.008	.951
Digit span forward	-.064	.951
Digit span background	.101	.452
Rey_RI_c	-.235	.075
Rey_RD_c	-.394	.002
FAS_c	-.236	.074
TMTA-c	.163	.222
TMTB_c	.012	.931
Matrici_c	.075	.578
FAB_c	.009	.947
CRI_Totale	.152	.255
ECRC_Alturistic_Totale	.313*	.017
SSS_Total	-.162	.223
SVS_guilibility	.075	.580
SVS_Credulity	.063	.641
SVS15_Totale	.072	.593
Past Scam experience	.145	.277

In the NCF group, no significant correlations were found between the donation task experimental condition and various demographic and cognitive variables. Specifically, there were no significant correlations observed between the donation task experimental

condition and age (r(58)= -.041, p=.763), years of education (r(85)=.042, p=.752), MMSE (r(85)= -.008, p=.951), Digit Span Forward (r(85)= -.064, p=.631), Digit Span Backward (r(85)= .101, p=.452), Rey Auditory Verbal Learning Test Immediate Recall (r(85)= -.235, p=.075), FAS (r(85)= -.236, p=.074), Trail Making Test Part A (r(85)=.163, p=.222), Trail Making Test Part B (r(85)=.012, p=.931), Raven's Progressive Matrices (r(85)=.075, p=.578), Frontal Assessment Battery (r(85)=.009, p=.947), Cognitive Reserve Index total (r(85)=.152, p=.255), SSS total (r(85)= -.162, p=.223), SVS total gullibility (r(85)=.075, p=.580), SVS credulity (r(85)=.063, p=.641), SVS15 total (r(85)=.072, p=.593), or past scam experiences (r(85)=.145, p=.277).

However, a significant correlation was observed between the donation task experimental condition and Rey Auditory Verbal Learning Test Delayed Recall (r(85)= -.394, p=.002), indicating a noteworthy association between experimental altruism and this specific cognitive measure in the NCF group.

Table 5: Correlation analyses donation task experiment (MCI group) with neuropsychological tests, CRI, ECRC Altruistic, SVS gullibility, SVS credulity, SVS15, past scam experience:

	Donation task experiment (MCI)	
	R (61)	P-value
Age	-.094	.470
Years of education	.171	.187
MMSE	.115	.376
Digit span forward	-.091	.492
Digit span background	.129	.378
Rey_RI_c	-.013	.922
Rey_RD_c	-.081	.536
FAS_c	.146	.246
TMTA_c	-.128	.338
TMTB_c	-.006	.972
Martici_c	.017	.900
FAB_c	-.083	.530
CRI_Totale	.248	.054
ECRC_Alturistic_Totale	-.015	.910
SSS_Total	.020	.877
SVS_guilibility	.257*	.046
SVS_Credulity	-.010	.939
SVS15_Totale	.088	.502
Past scam experience	.326*	.010

In the MCI group, no significant correlations were found between the donation task experimental condition and various demographic and cognitive variables. Specifically, there were no significant correlations observed between the donation task experimental condition and age (r(61)= -.094, p=.470), years of education (r(61)= .171, p=.187), MMSE (r(61)= .115, p=.376), Digit Span Forward (r(61)= -.091, p=.492), Digit Span Backward (r(61)= .129, p=.378), Rey Auditory Verbal Learning Test Immediate Recall (r(61)= -.013, p=.922), Rey Auditory Verbal Learning Test Delayed Recall (r(61)= -.081, p=.536), FAS (r(61)= .146, p=.264), Trail Making Test Part A (r(61)= -.128, p=.338), Trail Making Test Part B (r(61)= -.006, p=.972), Raven's Progressive Matrices (r(61)= .017, p=.900), Frontal Assessment Battery (r(61)= -.083, p=.530), Cognitive Reserve Index

total (r(61)= .248, p=.054), ECRC Altruistic Total (r(61)= -.015, p=.910), SSS Total (r(61)= .020, p=.877), p=.046), SVS credulity (r(61)= -.010, p=.939), or SVS15 Total (r(61)= .088, p=.502).

However, a significant correlation was observed between the donation task experimental condition and SVS gullibility (r(61)= .257*, past scam experiences in the MCI group (r(61)= .326*, p=.010), suggesting a noteworthy association between experimental altruism and prior experiences with scams within this group.

Table 6 Truffa (Q-square)

	MCI	**NCF**	**Q-square value (1,119)**	**P-value**
Past scam experience YES / NO	13 / 48	14 / 44	.135a	.713

No significant differences between NCF and MCI in the past scam experiences **Q2 (1) =.135a, p=.713**

Table 7: Correlation analyses of ECRC Altruism and susceptibility to scam scale, social vulnerability gullibility, social vulnerability credulity and past scam experience

ECRC_Alturism_totale

Variables	**R (119)**	**P-value**
SSS_Total	.041	.661
SVS_Guilibility	.183*	.047
SVS_credulity	.135	.144
Truffa (past scam experience)	.052	.547

The altruistic trait scale exhibits a significant positive correlation with SVS gullibility (r(119)=.183*, p=.047) and a non-significant correlation with past scam experience scale (r(119)=.052, p=.574). However, no significant correlations were found between the altruistic trait scale and the Susceptibility to Scam Scale (SSS) (r (119)=.041, p=.661), as well as the Social Vulnerability Scale credulity (r(119)=.135, p=.144).

Chapter 3

3. Discussion

Previous research has indicated that increasing altruism can greatly enhance the well-being of the elderly (e.g., Kahana et al., 2013). However, other studies have pointed out potential drawbacks of excessive altruism in older adults, including risks of burnout and diminished financial decision-making skills as they age (Bjälkebring et al., 2021; Wiesberger et al., 2022; Burnes et al., 2017). Some research also suggests that high levels of altruistic behavior in the elderly might be linked to a greater risk of falling victim to scams and financial exploitation (Bailey et al., 2021; Weissberg et al., 2022). Additionally, it's been shown that susceptibility to scams and social vulnerability defined as the likelihood of being exploited are more pronounced in individuals with Mild Cognitive Impairment and dementia (Pinsker et al., 2010; Boyle et al., 2019; Boyle et al., 2012; Han et al., 2015). The literature reveals a notable connection between diminished cognitive abilities and increased vulnerability to scams (Boyle et al., 2019; Boyle et al., 2012; Han et al., 2015), as well as between lower cognitive functioning and heightened altruistic behavior (Rosi et al., 2019; Weissberger et al., 2022).However, no study has tested the hypothesis of a relationship between increased altruistic behavior and greater social vulnerability and susceptibility to scams in both normal and pathological aging. The ProAging project, the focus of this thesis, is an exploratory study aimed at addressing a gap in the existing literature by investigating whether there is a correlation between prosocial behavior, social vulnerability, and susceptibility to fraud in a sample of elderly individuals with normal cognitive functioning (NCF) and with mild cognitive impairment (MCI). Our study also covered several secondary objectives related to cognitive impairment in the elderly. We compared elderly individuals with and without cognitive

impairment in terms of altruistic behavior, social vulnerability, and susceptibility to scams, including their real-life experiences with scams. Additionally, we examined how cognitive ability and cognitive reserve relate to social vulnerability, scam susceptibility, and altruistic behavior in both groups.

For this aim, we recruited the study sample included elderly individuals aged 65 or older, divided into two groups: those with and those without cognitive impairment. Both groups required at least five years of schooling and informed consent. The non-impaired group had an MMSE score of 24 or higher and no cognitive impairment diagnosis. The impaired group included those diagnosed with Mild Cognitive Impairment (MCI) or other cognitive impairments, with an MMSE score of 20 or higher. Poor Italian language skills were an exclusion criterion for both groups. The study seeks to understand the differences between these two groups in the relationship between these various factors. Additionally, to provide a more comprehensive picture, the relationship between cognitive abilities and these variables was analyzed to determine if, and to what extent, cognitive decline may influence prosociality, social vulnerability, and susceptibility to fraud in the two groups under study. This approach aims to shed light on the intricate dynamics of how cognitive functioning affects social behaviors and vulnerabilities in aging populations, potentially offering valuable insights for interventions and support strategies tailored to different cognitive profiles.

From preliminary analyses aimed at understanding the differences between groups on cognitive abilties, analyses revealed significant differences between elderly individuals with normal cognitive function (NCF) and those with MCI. As expected, older adults without cognitive impairment outperformed those with MCI across various cognitive domains, including short-term memory, working memory, processing speed, memory

recall, and reasoning. These results align with existing literature, reinforcing the notion that older adults without cognitive impairment performed cognitively better than the MCI (Belleville et al., 2017; Borella et al., 2013; Murman, 2011; Boyle et al., 2012). This decline in cognitive function likely contributes to the challenges faced by older adults with MCI in daily decision-making, including their susceptibility to scams.

Another important result regards the differences between NCF and MCI in the prosocial behavior. Specifically, we used a donation task that is designed to evaluate altruistic behavior by presenting participants with a hypothetical scenario where they imagine winning 100 euros in a contest and must decide how much to donate to a person shown in a photograph. The task includes two conditions: in the Control Condition, participants see a photo of a young adult with no additional information and are asked how much they would like to donate. In the Experimental Condition, participants are informed that the person in the photo has low economic resources. This added context assesses whether the recipient's financial situation influences the participant's willingness to donate and the amount given. The donation amount, ranging from 0 to 100 euros, serves as a measure of altruistic behavior. The donation task findings further elucidate the influence of cognitive status on prosocial behavior. In the control condition, where no empathic concern was induced, there were no significant differences between the NCF and MCI groups in how they allocated money to others. This suggests that in the absence of emotional or descriptive context, cognitive status does not significantly influence prosocial behavior. This is in line with previous studies showing no differences in prosocial behavior between NCF and older adults with cognitive impairment (e.g., Bosch-Domènech & Nagel, 2010). However, when empathic concern was induced in the experimental condition, significant differences emerged between the two groups, such that NCF donated more money

compared to the MCI. One possible explanation for these results is that older adults with normal cognitive functioning (NCF) may have a greater ability to respond to emotional cues, driven by their superior cognitive resources, which allow them to process and act on empathic stimuli more effectively. Conversely, individuals with mild cognitive impairment (MCI) might find it challenging to interpret these emotional cues, leading to variations in donation behavior. While this offers an intriguing hypothesis, it's important to acknowledge that these interpretations remain speculative. Future research will be essential to delve deeper into and validate these proposed hypotheses.

The observed relationship between empathic concern, prosocial behavior, and social vulnerability particularly gullibility highlights a critical aspect of cognitive impairment. It appears that those with MCI may be more susceptible to manipulation or deception, potentially due to reduced critical thinking or heightened emotional responses, making them more vulnerable to scams.

The correlation analyses provide deeper insights into the factors influencing prosocial behavior in the experimental condition. Positive correlations between global cognitive function (as measured by MMSE scores), cognitive reserve, and performance on the donation task suggest that individuals with better cognitive abilities are more likely to engage in prosocial behavior when empathy is induced. This finding is consistent with previous research indicating a positive correlation between altruism and cognitive performance (Corrêa et al., 2018).

However, the study also found that higher levels of gullibility and past scam experiences were associated with increased prosocial behavior in the experimental condition. This suggests that individuals who are more gullible or have a history of being scammed may

be more responsive to empathic cues, possibly due to a lack of critical thinking or a heightened emotional response. This aligns with studies showing that older adults, in general, display greater emotional empathy, which can result in increased prosocial behavior but also raises their risk of being deceived (J. A. Sze et al., 2012; Gunderson & Brinke, 2021).

Interestingly, within the NCF group, a significant negative correlation was found between the donation task performance and delayed recall on the Rey Auditory Verbal Learning Test. This suggests that individuals with better memory retention may exhibit less prosocial behavior when empathy is induced. One possible explanation is that those with better memory and cognitive function may employ more critical and discerning approaches, leading to less impulsive, emotionally driven decisions.

The analysis of the Altruistic Trait Scale revealed important nuances in how altruistic traits relate to social vulnerability and past scam experiences. A significant positive correlation between altruism and gullibility suggests that more altruistic individuals are also more likely to be gullible, potentially making them more susceptible to influence or deception. This finding underscores the importance of distinguishing between altruism and susceptibility to scams, being altruistic does not necessarily equate to being more vulnerable to scams. Indeed, the lack of significant correlations between altruism and past scam experiences or general scam susceptibility (as measured by the Susceptibility to Scam Scale) suggests that while altruistic individuals may be more gullible, their kindness does not necessarily result in a higher incidence of being scammed.

The lack of significant differences between the NCF and MCI groups in past scam experiences further supports this notion. Despite the cognitive challenges faced by

individuals with MCI, their past experiences with scams do not differ significantly from those of cognitively healthy older adults. This indicates that cognitive impairment alone does not necessarily increase or decrease the likelihood of being scammed. However, factors such as gullibility and responsiveness to empathic cues may still play a crucial role in determining how individuals respond to scams or prosocial requests.

To summarize, the results of the analyses partially validated our hypothesis regarding the relationship between the different variables. Specifically, we found positive correlations between prosocial behavior and susceptibility to scams. This indicates that those who report a high degree of altruism and prosocial behavior are more likely to fall victim to deception. However, no correlation was found between prosocial behavior, and social vulnerability, particularly credulity.

Regarding the differences between the two groups, the data revealed that elderly individuals with MCI who donate more and therefore exhibit greater prosocial behavior are also more susceptible to fraud and are more likely to have been scammed in the past. In contrast, in the group of NCF, those who donate more and are more prosocial tend to have a stronger trait of altruism, with no significant relationship between prosocial behavior, susceptibility to fraud, and social vulnerability.

In terms of cognitive abilities, it was found that elderly individuals with higher cognitive levels and greater cognitive reserve tend to exhibit more prosocial behavior. Among the NCF sample, those who experience more difficulty with delayed memory also tend to show greater prosocial behavior.

Limitations

Several limitations of our study design, methods, and data may have influenced our findings. First, the sample size may have been insufficient to detect subtle differences or interactions. Additionally, the sample may not have been diverse enough in terms of socioeconomic status, education, or geographic location, potentially limiting the generalizability of our findings. Second, the scales used to measure, social vulnerability, and scam susceptibility, while validated, may not fully capture the complexity of these constructs. There could be unmeasured variables that impact these relationships. Third, the cross-sectional nature of the study limits our ability to infer causality. Longitudinal data would provide a clearer picture of how these relationships evolve over time. Fourth, self-reported data on scam experiences and altruistic behavior are subject to recall bias and social desirability bias, which may affect the accuracy of the responses. Lastly, the cognitive assessments used may not comprehensively cover all aspects of cognitive functioning relevant to scam susceptibility and altruistic behavior.

Implications and Future Directions

The findings from this study have important implications for understanding the vulnerabilities of older adults, particularly those with cognitive impairments, in relation to prosocial behavior and scam susceptibility. Interventions aimed at reducing gullibility in altruistic individuals, especially those with MCI, could help protect them from exploitation without diminishing their altruistic tendencies. Additionally, promoting awareness and critical thinking among older adults, particularly in emotionally charged situations, may mitigate their risk of being deceived.

Future research should continue to explore the intricate relationships between cognitive function, social vulnerability, and prosocial behavior in older adults. Longitudinal studies could provide valuable insights into how these relationships evolve over time, particularly as cognitive impairments progress. Furthermore, investigating the role of other emotional and social factors, such as loneliness or social isolation, could deepen our understanding of the factors contributing to scam susceptibility in this population.

Broader Theoretical Implications

The findings of this study contribute to the broader theoretical understanding of the interplay between cognitive function, social vulnerability, and prosocial behavior in aging populations. They challenge traditional theories that broadly link altruism with increased susceptibility to scams by highlighting that the relationship is more nuanced and mediated by specific cognitive and social factors, such as gullibility and emotional responsiveness. This suggests that theories of aging and vulnerability should not treat altruism as a monolithic trait but rather consider how different cognitive processes and social vulnerabilities interact to influence behavior. The study also adds to the growing body of literature on socioemotional selectivity theory, which posits that older adults prioritize emotionally meaningful experiences. Our results indicate that this focus on emotional relevance can be both protective and risky, depending on the cognitive and social context. This nuanced view emphasizes the importance of considering individual differences in cognitive capacity and social vulnerability when developing theoretical models of aging, altruism, and susceptibility to exploitation.

Advancing Understanding of the Research Problem

This study advances our understanding of the complex relationship between cognitive function, altruism, social vulnerability, and susceptibility to scams among elderly individuals. By differentiating between general altruistic tendencies and specific vulnerabilities like gullibility, the research provides a more detailed view of how cognitive impairment influences the risk of exploitation. Previous research often treated altruism as a straightforward risk factor for scams, but our findings suggest that the risk is more closely tied to the interaction between cognitive decline and social vulnerabilities, such as the tendency to trust others easily. This nuanced understanding helps clarify why some elderly individuals are more susceptible to scams than others, even when they exhibit similar levels of altruism. Moreover, the study highlights the importance of considering emotional and social contexts in assessing vulnerability, offering new insights into how interventions could be tailored to protect at-risk populations more effectively. By refining the conceptual framework around altruism and scam susceptibility, this research deepens the field's understanding of the specific factors that contribute to the exploitation of elderly individuals, particularly those with cognitive impairments.

Conclusion

In conclusion, this study highlights the complex interplay between cognitive function, altruistic behavior, social vulnerability, and scam susceptibility in elderly individuals.

Previous research has demonstrated that increased altruism in the elderly can positively impact their well-being (Kahana et al., 2013). However, excessive altruism can sometimes lead to negative outcomes (Bjälkebring et al., 2021; Wiesberger et al. 2022; Burnes et al. 2017). Moreover, excessive altruistic behavior has been linked to a higher risk of susceptibility to scams and financial exploitation (Bailey et al., 2021; Weissberg et al., 2022). Studies also show that individuals with Mild Cognitive Impairment (MCI) or dementia experience heightened social vulnerability and susceptibility to scams (Boyle et al., 2019; Boyle et al., 2012; Han et al., 2015). The literature indicates that low cognitive abilities correlate with increased susceptibility to scams (Boyle et al., 2019; Boyle et al., 2012; Han et al., 2015) and greater altruistic behavior (Rosi et al., 2019; Weissberger et al., 2022). Despite these findings, there has been limited research directly examining the interplay between altruistic behavior and susceptibility to scams in both normal and pathological aging.

The Study aimed to address this gap by exploring correlations between prosocial behavior, social vulnerability, and susceptibility to fraud in elderly individuals with normal cognitive functioning (NCF) and those with MCI. The study sought to compare these two groups regarding altruistic behavior, social vulnerability, and scam susceptibility, including their real-life scam experiences. Additionally, it aimed to examine how cognitive ability and cognitive reserve relate to these factors in both groups.

Our analysis confirmed significant cognitive differences between the NCF and MCI groups. As expected, individuals with NCF outperformed those with MCI across various cognitive domains, including memory and reasoning. This cognitive decline in MCI likely contributes to challenges in daily decision-making and increased susceptibility to scams.

The donation task used to assess altruistic behavior revealed that in the absence of empathic cues (Control Condition), there were no significant differences between the NCF and MCI groups in donation behavior. This suggests that cognitive status alone does not influence prosocial behavior without emotional context. However, when empathic concern was induced (Experimental Condition), NCF individuals donated significantly more than those with MCI. This finding implies that superior cognitive resources in NCF individuals may enhance their ability to respond to emotional cues, whereas those with MCI may struggle with interpreting these cues.

Correlation analyses showed that higher gullibility and past scam experiences were associated with increased prosocial behavior under empathic conditions. This suggests that individuals who are more gullible or have a history of being scammed may be more responsive to empathic cues, potentially due to reduced critical thinking or heightened emotional responses. Among NCF individuals, better cognitive function and cognitive reserve correlated with higher prosocial behavior, though better memory retention was linked to less impulsive decision-making.

The findings underscore the importance of distinguishing between altruism and vulnerability to scams. While more altruistic individuals may be more gullible, this does not necessarily result in a higher incidence of being scammed. Interventions should focus on reducing gullibility and enhancing critical thinking, particularly in those with MCI, to

protect them from exploitation without diminishing their altruistic tendencies. Additionally, promoting awareness about scam risks and emotional decision-making may help mitigate susceptibility.

Future research should build on these findings by employing longitudinal designs to better understand how cognitive function and social vulnerabilities evolve over time. Investigating additional factors, such as loneliness or social isolation, could provide further insights into scam susceptibility. Expanding studies to include more diverse samples and using comprehensive cognitive assessments will help refine our understanding of the relationship between cognitive impairment, prosocial behavior, and scam vulnerability.

This study contributes to a nuanced understanding of how cognitive function impacts altruistic behavior and susceptibility to scams in elderly populations. By differentiating between altruistic tendencies and specific vulnerabilities, it offers valuable insights for developing targeted interventions and enhancing the protection of at-risk older adults.

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