Research Paper

Mediating Role of Inhibition Control in the Relationship Between Age and Memory Changes Throughout Adulthood: An Aging Developmental Study in Iran

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ABSTRACT

Introduction: This study aimed to investigate the age trends in various types of memory, including priming, working memory (WM), episodic memory (EM), and semantic memory (SM) from adulthood to old age, as well as the mediating role of inhibition control (IC) in the relationship between age and memory.

Methods: A total of 796 healthy adults aged between 25 and 83 years participated in this cross-sectional study. They underwent assessment using a comprehensive battery of memory tests (adapted from the Betula battery), digit span tasks (to measure WM), and the Stroop color-word test (to measure IC).

Results: The scatter plot with locally estimated scatterplot smoothing (LOESS) fitting line showed EM and WM declined steadily from age 25, while SM exhibited a mild increase up to age 55 followed by a decline. Priming did not show significant changes with age. Mediation analysis and bootstrap tests indicated that IC mediated the relationship between age and EM (β=–0.097, P=0.002) and between age and SM (β=-0.086, P=0.001).

Conclusion: Our results showed that age affects various types of memory differently, and inhibition control plays a fundamental mediating role in explaining age-related declines in SM and EM.

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Highlights

• Age affects differently on various types of memory.

• While episodic and working memory are highly age sensitive, semantic memory shows a less decline from the aging process and priming doesn't change with age.

• Inhibition control plays a mediating role between age and decline in episodic and working memory.

Plain Language Summary

Although memory decline is more common in the elderly, the age at onset of memory decline is different between people. The inhibitory control ability plays a critical role in human memory. It is important to investigate its role in the relationship between aging and memory. In this study, we assessed this mediating role in healthy adults aged 25-83 years. It was found that episodic memory and working memory declined steadily from age 25 onwards, while semantic memory showed a mild increase up to age 55 and then declined. The inhibitory control mediated the relationship between aging and episodic memory and between aging and semantic memory. Therefore, it can be concluded that aging affects the types of memory differently, and inhibition control plays a mediating role in explaining age-related memory declines.

1. Introduction

The continuous increase in life expectancy has led to profound changes in population structure, with an ongoing growth of the elderly population (Oeppen & Vaupel, 2002; Lutz et al., 2008). Globally, the number of individuals aged 65 years or over is estimated to grow to one billion by 2030 (Dobriansky et al., 2007). With this growth, poor cognitive function probably is the most disabling condition in the elderly (Singh-manoux et al., 2012). While there is ample evidence that progressive memory decline is a normal component of the aging process (Boyle et al., 2013), there are considerable differences between individual trajectories and the onset of age-related memory decline (Finch, 2009; Salthouse, 2009).

According to the multiple memory systems theory proposed by Tulving (1985), human memory is divided into various subtypes, namely semantic memory (SM), episodic memory (EM), working memory (WM), and priming. Existing literature suggests that each subtype exhibits varying degrees of cognitive decline and onset age. Episodic memory is particularly sensitive to age and experiences the most substantial age-related decline (Bäckman et al., 2000; Nyberg et al., 2003; Rönnlund et al., 2005; Vieweg et al., 2015). However, studies differ regarding the age at which this decline begins. While some indicate onset at or before 60 years old (Schaie, 2005; Salthouse, 2009), others found no evidence of decline before age 60 (Hedden & Gabrieli, 2004). Working memory, like episodic memory, declines with age (Hultsch et al., 1992; Park et al., 2002, Klencklen et al., 2017). However, this decline differs based on the type of information being processed and remembered, with visuospatial WM declining earlier than verbal WM (Chen et al., 2003). Unlike EM and WM, SM exhibits stability and continued improvement until at least age 60, only slightly declining after the age of 75 (Salthouse, 2009; Ofen & Shing, 2013). Despite this stability, aging still compromises the ability to access the information stored in SM (Craik & Bialystok, 2006). Studies treating priming as a form of implicit memory found no significant age-related decline (Rybash, 1996; Fleischman, 2007). Results from the Betula project indicate a significant decline in EM around age 35, along with a decline in SM after an initial improvement up to ages 55-60, and a consistent trend in WM (Nilsson, 2003). In this project, age was the only variable significantly predicting EM, but not SM performance, when controlling for the effects of education and intelligence (Nyberg et al., 1996).

There are various theories that explain how aging may cause a decline in cognitive functions (Birren, 1965; Salthouse, 1996; Craik & Lockhart, 1972). One of the most reliable theories is the inhibitory theory of memory deficits with age (Hasher & Zacks, 1988). This theory states that inhibitory control (IC), or the ability to filter out unnecessary stimuli, plays a critical role in human memory

(Hasher & Zacks, 1988; Hasher et al., 2007). Age-related decline in attention control is associated with more distractibility and lower focused attention, which in turn causes memory decline, especially in EM (Park & Festini, 2017). Therefore, it is important to investigate the mediating role of IC in the relationship between age and memory.

There is inconsistency in the current literature regarding the role of IC as a mediator between age and memory. While some studies suggest that poor IC, especially in old age, indicates a decline in WM performance (Head et al., 2008; Fabiani, 2012), others do not support this finding (Salthouse et al., 2003; Borella et al., 2008). Evidence also suggests that this role depends on the type of memory tasks; it is more pronounced in more active and complex tasks (Van Gerven et al., 2007). Spaan (2015) also found that IC mediates the relationship between age and EM, but does not have an effect on SM. On the other hand, the results of Dias et al. (2018) showed that the relationship between IC and memory depends on age, and IC may be a compensatory mechanism for impaired memory in older people.

Consistent with previous studies, it is assumed that aging leads to the most significant decline in EM and WM causes a lesser decline in SM, but does not impact priming. This study seeks to investigate the general age trends of various types of memory, including priming, SM, EM, and WM, as well as the mediating role of IC in age-related memory decline. The data used in this study were obtained from the "Sepidar" project (Hatami et al., 2018).

2. Materials and Methods

Participants

This study involved 796 healthy adults aged between 25 and 83 years who did not exhibit cognitive deficits, including mild cognitive impairment, Alzheimer's disease, and dementia. The participants were selected from a subgroup of the "sepidar" project, a long-term study conducted at the University of Tehran.

All participants were assessed using the mini-mental state examination (MMSE), Stroop color-word test (SCWT), digit span test (forward and backward), and a comprehensive computerized battery of memory tasks based on the Sepidar battery; (Hatami et al., 2018). Assessments were conducted in person by a licensed clinical psychologist (Mottaghi Ghamsari) at the Cognitive Rehabilitation Laboratory at the University of Tehran. Data collection occurred annually over a period of 3 years, from September 2014 to September 2017.

The participants included in the study were able to speak and write Farsi. Those who had mild cognitive impairment according to the MMSE (A score of 23 or lower); (Ansari et al., 2010), reported auditory or visual impairments or had a history of serious brain disorders (e.g. stroke and traumatic brain injury) were excluded from the study. All participants gave informed written consent prior to the completion of the assessments. The consent emphasized voluntary participation and the ability to withdraw from the study at any time. Participants were informed that demographic and cognitive testing would be conducted over two sessions lasting 1 to 1.5 hours each and that data would be stored anonymously and confidentially. At the conclusion of the study, participants were fully briefed on its purpose.

Measures

Demographic information

Information on age, gender, years of education, marital status, and health status (including medical history and physical symptoms) was collected through self-reporting.

MMSE

A general cognitive screening was conducted using the MMSE. The MMSE comprises 11 questions commonly asked to screen for cognitive deficits in domains such as orientation, WM, attention, delayed recall, and language (Folstein et al., 1975). The total score of the MMSE ranges from 0 to 30, with a higher score indicating greater cognitive performance. The Persian version of the MMSE, which has received validation from Ansari et al. (2010), was used in this study.

Betula tests

The translated version of the Betula battery developed by Nilsson et al. (1997) was employed (Hatami et al., 2018). This battery is composed of different tasks that assess various types of memory, including priming, SM, and EM. The present analyses focused on six episodic tests, one priming test, and five semantic tests from this battery. The testing procedures are briefly outlined below:

Episodic tests

Face-name recognition: Participants viewed 16 images of children with their full names and were tasked with remembering the children's last names. Approximately 30 minutes later, participants were presented with 24 faces (12 target and 12 distractor faces) and asked to identify the familiar images from the distractors. In the recognition phase, the same 16 images of children were shown again, and participants were required to select the first and last names of each child from a list of four options.

Recall of actions: Participants were instructed to memorize and recall two lists of 16 imperative sentences. One list was enacted by the participant during encoding, while the other list was encoded solely through auditory means. The number of sentences recalled from each list served as the quantitative measure in data analyses.

Cued recall of nouns: Participants received eight distinct noun categories (e.g. stationery, furniture, kitchenware, clothing, edibles, toys, tools, and sewing accessories), each containing four nouns. They were then asked to recall the nouns from imperative sentences given in the prior test, using these semantic cues. The accurately recalled noun count was utilized in the data analysis.

Recognition and cued recall of nouns: Participants were presented with a series of nouns and were required to identify those that had been used in sentences from the previous test. Subsequently, they were given a series of verbs and tasked with recalling the noun that accompanied each verb in those sentences. They also had to decide whether the verb was part of the sentences from the enactment category in the prior test.

Word recall under divided and focused attention: In this test, participants were given a list of 12 words and asked to recall the words immediately after listening. Participants had to complete this word recall under four different conditions: Sorting cards only during encoding, only during retrieval, during both encoding and retrieval and without sorting cards at any stage. Sorting cards required participants to divide their attention, whereas they could concentrate fully without this additional task. The number of words recalled under each condition was used in data analyses.

Recollection of completed activities: After completing the above assessments, participants were asked to recount all the tests they had undergone during the session. The number of tests that they were able to recall accurately served as the quantitative measure used in the analysis.

Priming test

Word stem completion: In this test, participants were presented with 32 two-letter word stems and asked to identify the first family name that came to mind starting with those word stems. Sixteen of these stems were from the last names presented in the face-name recognition test, while the remaining were distractors. The number of mentioned priming targets (presented family names in the face-name recognition test) was recorded as a measure in the analyses.

Semantic test

Word fluency (WF): In this assessment, participants were presented with five WF tests. In each test, they had one minute to list as many words as possible in a specific category. The five categories included words beginning with the letter "a", five-letter words starting with the letter "t", four-letter words beginning with the letter "b", professions beginning with the letter "m", and four-letter bird names. The number of words generated correctly in each test was recorded as the index of WF and used in the analyses.

To streamline the various memory variables, exploratory factor analysis was conducted following the approach by Hatami et al. (2018) This analysis yielded six factors, labeled in accordance with Betula (Nilsson et al., 1997), including SM, recall attention (RA), action memory (AM), name recognition (NR), WF, and priming. Cronbach's α for SM, RA, AM and NR were 0.91, 0.84, 0.76, 0.51, and 0.62, respectively. Since priming is measured by a single item, Cronbach's α was not calculated for it. Additionally, a composite score based on factors for the EM score was created using SM, RA, AM and NR (Hatami et al., 2018).

Psychology experimental language building (PEBL) tests

The PEBL tests were utilized in this study, including the translated versions of the forward and backward digit span tests (for assessing WM) and the SCWT (for measuring IC) from the PEBL test battery (Muller & Piper, 2014) as described by Hatami et al. in 2018 (Hatami et al., 2018). PEBL is a free and open-source battery with approximately 70 behavioral tests commonly employed in psychological and neuropsychological research.

Forward and backward digit span tests: In the forward digit span test, participants were presented with a series of numbers randomly selected from 0 to 9, delivered both auditorily and visually. The initial chain length consisted of three digits. Participants were instructed to recall the numbers they heard and saw in the same sequence. If a participant correctly recalled at least one of the two attempts in a chain, the chain length increased by one number. This process continued until participants either failed to recall or incorrectly recalled both attempts of a chain, or until they correctly recalled 10-digit chains (0 to 9). The backward digit span test is similar to the forward test, except participants were required to recall the chain of digits in reverse order. In each test, the final span of digits served as a measure in analyses.

SCWT: In this test, some words, including four color names (blue, yellow, green, and red) and neutral words, sequentially appeared on the screen in one of the four colors mentioned. In each attempt, participants were asked to press the key corresponding to the text color as quickly as possible regardless of its content (key 1 for red, key 2 for blue, key 3 for green, and key 4 for yellow). There were three conditions: A neutral condition with neutral words, a congruent condition where the text color and meaning of the color name were compatible, and an incongruent condition where the text color and meaning of the color name were incompatible. The first two conditions did not require IC, whereas, in the incongruent condition, participants had to perform a less automatic task (naming the font color) while inhibiting interference from a more automatic task (reading the word). An index for IC was determined by the reaction time in the incongruent condition and entered into the analyses. The first two conditions did not require IC, whereas, in the incongruent condition, participants had to perform a less automatic task (naming the font color) while inhibiting interference from a more automatic task (reading the word). An index for IC was determined by the reaction time in the incongruent condition and entered into the analyses.

Data analysis

Descriptive analysis was used to describe the demographic characteristics of the test subjects. ANOVAs and post hoc tests were used to compare memory performance between age groups. To investigate the age trends of various types of memory, the scatter plot with a locally estimated scatterplot smoothing (LOESS) fitting line (a method for fitting a smooth curve between two variables) was used. Finally, to measure the mediating role of IC in age-related memory changes, mediating analysis and the bootstrap test were used. The data were analyzed using SPSS software, version 26. The data for this project have been published and are accessible on the open science framework under the title "age trends of memory with mediating role of inhibition." Descriptive analysis was employed to outline the demographic characteristics of the test subjects. ANOVAs and post-hoc tests were utilized to compare memory performance among different age groups. To examine the age trends of various types of memory, scatter plots with LOESS fitting lines (a method for smoothing curves between two variables) were employed. Lastly, to assess the mediating role of IC in age-related memory changes, mediation analysis and the bootstrap test were conducted.

3. Results

Descriptive data

The initial sample comprised 819 participants, of whom 796 (527 females, 266 males, and three with missing gender information) completed the memory assessment. The average age of the participants was 48.39±14.24 years. The participants' demographic information is shown in Table 1. Cognitive function assessment in this study was conducted in two sessions. During the first session, EM and SM items were evaluated. In the second session, digit span tests and the SCWT were administered. A remarkable number of participants did not attend the second session; thus, data from 587 participants for digit span tests and from 563 participants for SCWT were analyzed. T Subsequently, the participants were categorized into five age groups: 25 to 34 years, 35 to 44 years, 45 to 54 years, 55 to 64 years, and 65 years and older.

Age trends of various types of memory

We conducted a one-way analysis of variance (ANOVA) for each memory test, using memory score as the outcome variable and the age group as the factor. Following ANOVA, significant pairwise comparisons were further analyzed by Tukey's post hoc test. In order to simplify the comparison between age groups, participants were divided into three groups: Younger adults (18–39 years), middle-aged adults (40–64 years), and older adults (65–88 years). The results of the ANOVA are summarized in Table 2.

One-way ANOVA revealed a significant age effect on all types of memory, and scores differed across the three groups. Pairwise comparisons confirmed that the memory scores were significantly higher for the younger adults than the middle-aged and older adults. Also, middle-aged adults performed significantly better than the older participants. The effect size for EM (η^2=0.348) was larger than that of WF (η^2=0.074), indicating that EM was influenced more by age. The age-related trends in the decline of various types of memory from adulthood (25 years) to old age (83 years) are illustrated in a scat-

Table 1. Characteristics of the study participants (n=796)

Variables		No. (%)
Age (y)	≤34	188(23.6)
	35-44	87(10.9)
	45-54	191(24.0)
	55-64	220(27.6)
	≥65	102(12.8)
	Missing	8(1)
Gender	Female	527(66.2)
	Male	266(33.4)
	Missing	3(0.4)
Education level (y)	High school diploma and below (≤12)	166(20.9)
	Bachelor's degree (13-16)	215(27.0)
	Master's/Doctoral degree (≥17)	202(25.4)
	Missing	213(26.8)
Marital status	Married	513(64.4)
	Single	158(19.8)
	Divorced	29(3.6)
	Widowed	29(3.6)
	Missing	67(8.4)

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ter plot with a LOESS fitting line. Due to differences in years of schooling, scores of each type were corrected by regressing them on education and using residuals. As seen in Figure 1, there was a gradual decline in SM and RA from 25 to 80 years, with a steeper slope after 50 years. In AM, a mild and monotonous decline was seen in adulthood. In these types of memories, the decrease in the slope accelerated after 60 years. Moreover, NR experienced a steady decline. According to the composite score of EM, it declined steadily with a mild slope up to 50 years, and memory decline occurred more rapidly thereafter. Similar to EM, WM also decreased from 25 to 80 years. The declining slope of this type of memory was relatively mild and steady. The age-related trend of WF was different from EM. This memory had a mild improvement up to 55 years, then experienced a much more rapid decline. Priming scores did not significantly change with increasing age. As seen, the plots did not change significantly after taking the effect of varying education levels into account.

The mediating role of IC in memory changes

In order to determine the direct effects of aging on memory, a partial mediation model was created for each memory type. The strength of each relationship is shown in Figure 2. Based on the literature, this model hypothesized that aging would have a negative effect on IC, which in turn would have a negative effect on memory. Excluding NR, all tested indirect effects were significant. In this model, age negatively influenced IC (β=-0.561, $P<0.01$), and the impairment in IC affected SM (β=-0.087, P=0.001), AM (β=-0.075, P=0.003), RA (β=-0.097, P=0.002), EM (β=-0.097, P=0.002) and WF (β=-0.086, P=0.001). The regression weights of each structural path are presented in Table 3.

Table 2. Descriptive information and analysis of age group differences in memory performance tasks

Variables	Mean±SD			ANOVA on Group Differences			Significant Pairwise Comparisons
	Y (n=227)	M (n=459)	O (n=102)	F	P	η^2	
SM	0.519±0.790	-0.090±0.841	-0.774±0.805	93.25	0.001	0.192	Y>M>O
AM	0.414±0.689	-0.050±0.752	-0.740±0.832	86.30	0.001	0.180	Y>M>O
RA	0.593±0.614	-0.119±0.573	-0.810±0.563	224.61	0.001	0.364	Y>M>O
NR	0.418±0.762	-0.089±0.639	-0.529±0.505	82.12	0.001	0.173	Y>M>O
EM	0.507±0.533	-0.093±0.529	-0.733±0.515	209.95	0.001	0.348	Y>M>O
WF	0.190±0.586	0.018±0.729	-0.445±0.591	31.41	0.001	0.074	Y>M>O

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Abbreviation: SM: Sentences memory; AM: Action memory; RA: Recall-attention; NR: Name recognition; EM: Episodic memory; WF: Word fluency; Y: Young; M: Middle; O: Old.

4. Discussion

The aim of this study was to investigate the age trends of various types of memory in a sample of Iranian adults. The results showed that all types of memory changed significantly with age, with priming being the only exception. These differences were more pronounced in EM and WM, and less significant in WF. EM declined in all age groups, with the most significant decrease occurring after 55-60 years. Similar to EM, WM also declined in all age groups. Performance in WF (SM index) improved up to 55 years and then began to decline. Priming remained nearly constant and did not decline from adulthood to old age. These findings are in line with and validate the current literature (Nyberg et al., 2003; Bäckman et al., 2000; Rönnlund et al., 2005; Schaie, 2005; Hultsch et al., 1992).

The variance in the effects of aging on SM compared to EM and WM may be explained by their infrastructural components. EM and WM are based on fluid intelligence (Nyberg et al., 1996), whereas SM is a type of crystallized intelligence scale (Small et al., 2011). Various studies have shown that fluid intelligence declines from young age to old age, while crystallized intelligence remains steady and may even grow with age (Horn & Cattell, 1967; Willis & Baltes, 1980; Zaval et al., 2015). The unique nature of priming may also help explain its stability characteristic over the lifespan. SM, EM, and WM are forms of declarative memory (Moscovitch et al., 2006). Declarative memory consists of memory for events and facts that can be explicitly stored and retrieved (Tulving, 1985). While different types of declarative memory are related to each other, as well as to other cognitive functions, such as verbal processing speed and verbal comprehension, which are age-related,

Table 3. Mediation effects of inhibition decline on the relationship between age and memory types (indirect effects)

Path		Age Inhibition Impairment					
		SM	AM	RA	NR	EM	WF
Unstandardized coefficient		-0.006	-0.004	-0.005	-0.002	-0.004	-0.004
Standardized coefficient (β)		-0.087***	-0.075**	-0.097**	-0.046	-0.097**	-0.086***
Standard error		0.025	0.025	0.027	0.024	0.022	0.028
Significance level		0.001	0.003	0.002	0.063	0.002	0.001
Bootstrap boundaries (%95 CI)	Lower bound	-0.135	-0.130	-0.138	-0.094	-0.140	-0.145
	Upper bound	-0.039	-0.031	-0.054	-0.002	-0.054	-0.034

P<0.01,*P<0.001.

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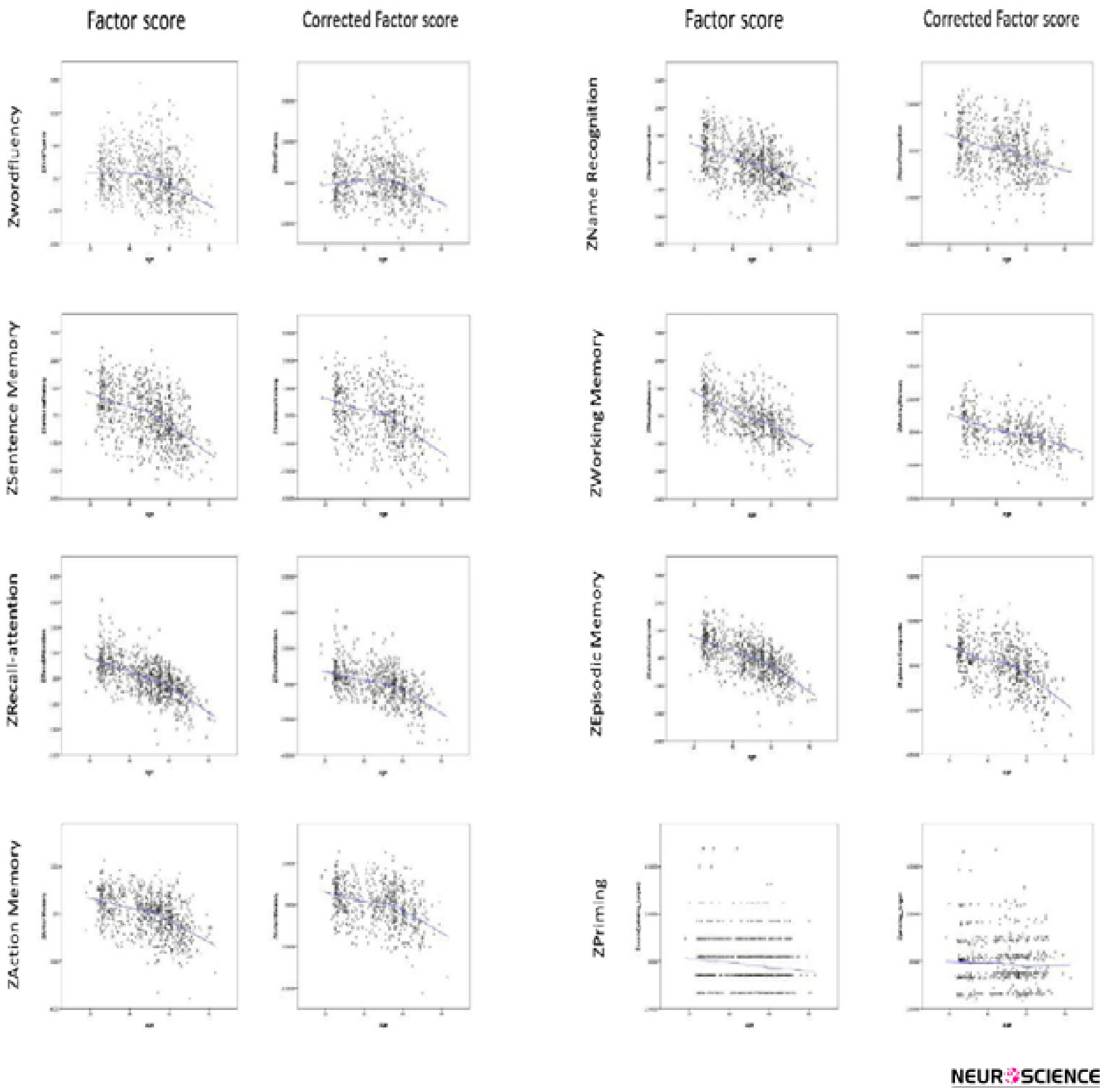

Figure 1. Scatter plots of corrected vs. non-corrected memory factor scores against age with LOESS fitting line (shadows indicate 95% CI)

priming has no relation to declarative memory types nor to other cognitive functions (Hultsch et al., 1991). Since priming differs from other types of memory, it can be implied that its underlying mechanisms and related processes are also different.

In addition to investigating the changes in human memory with increasing age, this study also sought to investigate the mediating role of IC in the relationship between age and memory. The results showed that IC mediates the effect of aging on both EM and WF. This finding is in line with some previous studies, which illustrated that the intermediate role of IC in memory and aging was significant to varying extents (Head et al., 2008; Bäuml et al., 2010; Fabiani, 2012; Spaan, 2015). However, other studies found this role to be either negligible or does not exist (Salthouse et al., 2003; Borella et al., 2007).

EM relies on the processes of WM, in which the ability to suppress unrelated thoughts is important (Plancher et al., 2018). The inhibitory theory of age-related memory deficit, proposed by Hasher & Zacks (1988), suggested that IC reduces the activation of off-goal-path thinking levels in WM and facilitates sufficient memory processing. The significant relationship between IC and memory is in line with the perspective that successful memory retrieval depends on the ability to ignore irrelevant information and focus on the target information (Park &

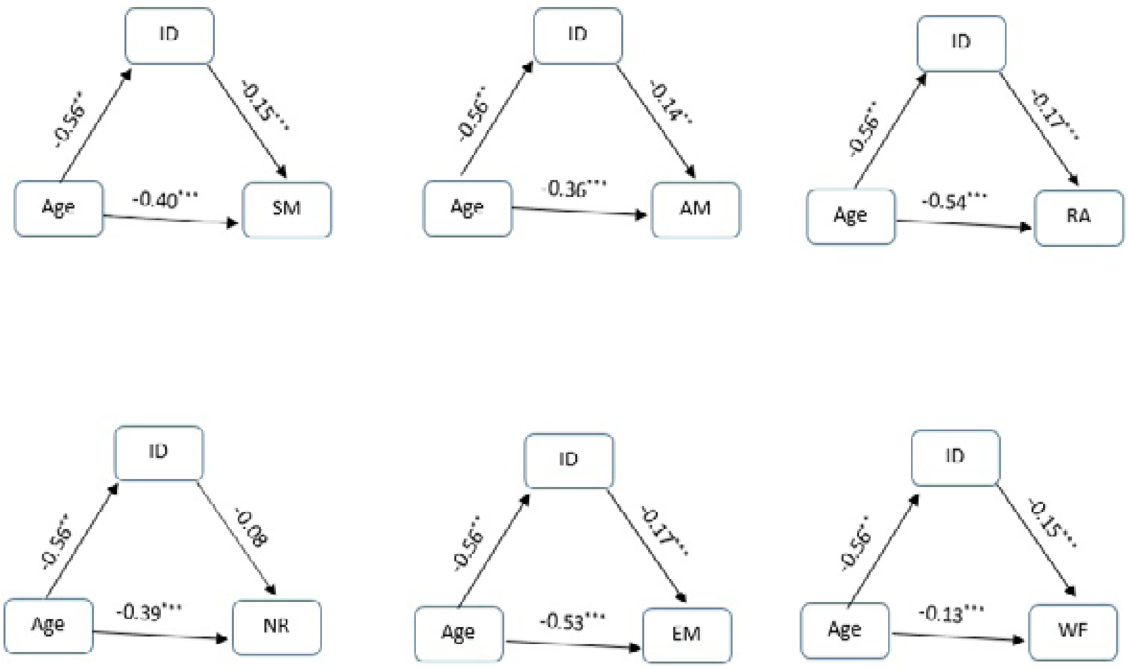

Figure 2. Partial mediation models (direct effects)

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Abbreviation: ID: Inhibition decline; SM: Sentences memory; AM: Action memory; RA: Recall attention; NR: Name recognition; EM: Episodic memory; WF: Word fluency.

Note: Arrows reflect relationships between variables. Standardized coefficients are shown next to each path.

**P<0.01,***P<0.001.

Festini, 2017). IC is largely related to WM, controls the flow of information within WM, acts to prevent unrelated information from entering WM, and suppresses information that is no longer relevant (Hasher & Zacks, 1988; Zacks & Hasher, 1994).

Elderly individuals with impaired IC are easily distracted and more likely to focus on background information rather than the target information presented to them (Diamond, 2013). Poor IC results in diminished selective attention and confusion in WM, thereby restricting the ability to absorb new information. Additionally, this mental disorganization leads to competition during memory retrieval, resulting in increased processing time, decreased data entry rates, and memory interference in elderly individuals (Park & Festini, 2017).

However, it appears that the mediating role of IC in explaining age-related memory decline depends on the characteristics of the task. While the impact of IC is evident in tasks requiring WM processing capacity, it is less apparent in tasks reliant on WM storage capacity (Van Gerven et al., 2007; De Bruin & Sala, 2018). Aging may be associated with selective rather than generalized reduction in IC, and there are multiple inhibitory mechanisms. For instance, inhibitory mechanisms supported by the dorsal-ventral visual pathways remain consistent in both young and old adults, whereas mechanisms governed by the frontal lobe exhibit age-related deficits (Kramer et al.,1994; Rey-mermet & Gade, 2018).

When analyzing the collected data, it is crucial to consider the limitations that may have compromised the accuracy of this study. Firstly, since this study was cross-sectional, did not assess the changes in memory function of the participants over time. Given that a longitudinal study is more sensitive to these changes, conducting such a study may provide a more reliable and accurate picture of the age-related trends of memory over time. Additionally, due to the voluntary nature of sampling, most participants were women and had post-secondary education. Thus, the present results must be interpreted and generalized with caution.

5. Conclusion

In conclusion, it was found that the aging process has a unique impact on each type of memory. While EM and WM were found to be highly age-sensitive, SM was found to experience a less significant impact from the aging process. Priming, on the other hand, did not exhibit age sensitivity. The differences in the infrastructural components of memory types can support and explain the results of this study. Moreover, the results confirm the mediating role of IC in the relationship between increasing age and the decline in EM and WF. This study provides valuable insights regarding the changes in memory types in adulthood as well as the influence of IC in age-related memory changes.

Ethical Considerations

Compliance with ethical guidelines

The present study was approved by the Ethics Committee of Iran University of Medical Sciences.

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Authors' contributions

Study design: Javad Hatami; Data analysis: Hossein Karsazi; Experiments and writing the original manuscript: Atieh Sadat Mottaghi Ghamsari; Review and editing: Reza Kormi-Nouri.

Conflict of interest

The authors declared no conflict of interest.

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