

The Influence of Age and Learning Preferences on Memory Retention: A Comparative Study of Pictures Versus Words

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Abstract

Memory retention is a fundamental aspect of learning, influenced by factors such as age and individual learning preferences. This study explores how different age groups retain information when presented with both pictorial and textual stimuli, assessing which medium enhances memory retention more effectively. By integrating cognitive development theories, and educational psychology, this research examines the interaction between age-related cognitive changes and the nature of stimuli in shaping memory performance. The findings demonstrate that visual stimuli significantly improve memory recall compared to written text, particularly among younger participants. This supports existing literature on the role of imagery in enhancing cognitive processing. Through empirical analysis and a review of related studies, the research offers insights into how educators can optimize learning methods by incorporating visual materials, particularly for younger learners. The study highlights the importance of adapting educational practices to cater to the diverse cognitive needs of learners across different age groups.

Keywords: Memory Retention, Age-Related Cognitive Changes, Learning Preferences, Cognitive Development Theories, Picture Superiority Complex (PSE), Educational Psychology

Introduction

Memory is a cornerstone of human cognition, integral to learning, problem-solving, and everyday functioning. Understanding how different factors influence memory retention is essential for educators aiming to optimize learning experiences across diverse age groups and learning preferences (Pillado, Futralan, & Comighud, 2020). Among these factors, age plays a crucial role, as cognitive development evolves significantly from childhood through adulthood and into old age (Murman, 2015). Young children undergo rapid neural development and often demonstrate heightened sensitivity to visual stimuli, as their cognitive structures are still developing, making them particularly attuned to visual information

during early stages (Gualtieri & Finn, 2022). As individuals progress through different stages of life, their ability to learn and retain new words typically follows a bell curve pattern, with notable declines in older age. Research indicates that cognitive functions, including processing speed, working memory, and executive functions, generally decrease with age, affecting memory retention despite efforts to maintain cognitive health (Murman, 2015). For instance, learning new skills is most effective before adolescence, with sensitivity to raw probabilities of events decreasing significantly around age 12 (Janacek, Fiser, & Nemeth, 2012).

Building upon foundational theories of memory retention, this study draws on Ebbinghaus's Forgetting Curve (1885), which highlights the rapid decline of memory over time without reinforcement, and Paivio's Dual Coding Theory (1986), which suggests that information encoded both visually and verbally enhances retention. Additionally, Tulving's work on retrieval processes (Tulving & Pearlstone, 1966) provides insights into how memory failures often stem from inefficient retrieval rather than loss of information. By integrating these theories, this research examines how different age groups process and retain visual versus textual stimuli, adding depth to existing knowledge on cognitive development and learning preferences.

The VARK model, introduced by Fleming and Mills (1992), categorizes learners into Visual, Auditory, Reading/Writing, and Kinesthetic preferences, highlighting that different learners process information more effectively using their preferred modalities. Younger children, for example, often respond better to visual stimuli, such as pictures, due to their developmental stage favoring visual processing. In contrast, adults and older individuals may show varying responses to different types of stimuli, such as written words versus images.

While prior research has established the Picture Superiority Effect (PSE), which suggests that images enhance memory retention more effectively than words (Paivio, 1986; Brady et al., 2008), fewer studies have explored how this effect interacts with cognitive aging and individual learning preferences across the lifespan. By addressing this gap, this study expands on existing literature and offers empirical insights into how memory retention strategies can be optimized for different age groups.

This study investigates the comparative effects of reading words versus viewing pictures on memory retention across different age groups. The study seeks to offer insights into how instructional strategies can be customized to align with individual learning preferences and cognitive differences associated with age. In doing so, it provides practical applications for educational psychology by demonstrating how instructional methods can be adapted to accommodate cognitive strengths and limitations at different life stages. The findings are anticipated to have significant implications for designing educational practices that enhance learning and memory retention throughout the lifespan.

Literature Review

Early Research and Foundational Theories

The study of memory retention has a long history in psychology, with some of the earliest theories coming from foundational research. In the late 19th century, Hermann Ebbinghaus was a pioneer in experimental memory research. He introduced the idea of the Forgetting Curve, which shows how quickly we lose information over time if we don't make an effort to retain it. His findings highlighted that memory retention drops sharply soon after learning, making it clear that time plays a crucial role in how well we remember things (Ebbinghaus, 1885).

Building on Ebbinghaus's work, Endel Tulving made significant contributions to the field in the 1960s by distinguishing between different types of memory, such as declarative and procedural memory. Tulving's research shed light on the role of retrieval cues, showing that memory failures aren't just about forgetting but can also result from poor retrieval strategies. This insight opened the door for further research into how we retrieve memories and what factors affect that process (Tulving & Pearlstone, 1966).

Why Pictures Are Better Remembered

Numerous studies have shown that visual stimuli, like pictures, are often easier to remember than verbal information. This effect, known as the picture superiority effect (PSE), suggests that images are more memorable because they engage multiple cognitive processes, such as visual encoding, emotional responses, and associations with existing knowledge (Paivio, 1986; Brady et al., 2008). Research by Oates and Reder (2010) found that participants were more likely to remember pictures than words, attributing this to the richer encoding of visual information. Studies by Mayer and Moreno (2003) also showed that pictures lead to deeper processing compared to words, creating stronger memory traces.

Further support for the PSE comes from Michael & Coffman (1956) and Paul (2024), who found that recognition memory for pictures was better than for words, even after retention intervals of up to two weeks. Schacter, Israel, & Racine (1999) suggested that pictures are more distinctive due to their complex perceptual features, making them more memorable than words. This aligns with Nelson, Reed, & Walling (1976) explanation of the PSE, which indicates that pictures engage richer semantic processing.

Neuroimaging studies provide additional insights into why pictures are remembered better. Different brain regions are activated when processing verbal and visual stimuli. For instance, while words primarily activate left hemisphere regions associated with language processing, visual stimuli trigger medial temporal activation, which is associated with memory encoding (Marois & Ivanoff, 2005). The medial temporal cortex, crucial for episodic memory, shows greater activity during the encoding of pictures compared to words, suggesting that pictures enhance memory

encoding through their distinctiveness and novelty (Morris, Bransford, & Franks, 1977).

Paivio's Dual Code Theory (Paivio & Csapo, 1973) further explains this phenomenon by proposing that pictures activate both visual and verbal codes, leading to a stronger memory representation. In contrast, words typically engage only a verbal code, resulting in a less comprehensive memory trace. This dual representation increases the likelihood of recalling pictures compared to words (Paivio, 1979; 1986).

Cognitive Development and Age-Related Changes

Cognitive development theories, especially those by Piaget and Vygotsky, highlight the role of age in memory retention. Piaget's stages of cognitive development suggest that children's ability to process and remember information improves as they grow, with younger children showing a stronger preference for visual stimuli (Piaget, 1952). Research also shows that as people age, their cognitive abilities, including memory retention, may decline. For example, older adults often have difficulty with written information due to slower processing speed and reduced working memory capacity (Murman, 2015). This contrasts with younger individuals, who generally have better recall for visual information (Tas, Costello & Buss, 2020).

Whitehouse, Maybery, & Durkin (2006) found that while children could read and understand information, their ability to recall pictures improved as they got older. They suggested that younger children might struggle to label pictures as easily as older individuals, which affects their ability to recall visual information. Robertson and Köhler (2007), found that a child's ability to label a picture plays a significant role in their visual memory performance.

Recent Developments in Memory Research

Recent advancements in neuroscience and cognitive psychology have shed light on how memory retention and retrieval work. For instance, studies have examined the neurobiological basis of memory retrieval, focusing on how memory traces interact with retrieval cues (Radvansky et al., 2022). This research emphasizes the need to understand how different stimuli, like pictures and words, activate distinct neural pathways, which in turn affect memory performance.

Additionally, new research on retrieval practice has shown that actively recalling information boosts memory retention more effectively than simply reviewing material (Roediger & Butler, 2011). This has important implications for education, suggesting that using retrieval-based strategies can enhance learning outcomes for people of all ages.

Empirical Studies and Application

Numerous empirical studies have explored how age and learning preferences affect memory retention. For example, Hockley (2008)

investigated the picture superiority effect in associative recognition and found that participants had a higher hit rate for picture pairs than word pairs, suggesting that pictures offer a significant encoding advantage over words. Defeyter, Russo, and McPartlin (2009) studied how the PSE develops across different age groups, showing that recognition memory for pictures improves with age. Their research found that while younger children could recognize pictures, their performance was still behind that of older participants, highlighting the developmental progression of memory retention.

Methodology

Participant Recruitment

A total of 80 participants were recruited across four age groups: 20 children (ages 5-12), 20 teenagers (ages 13-19), 20 adults (ages 20-60), and 20 elderly individuals (ages 61 and above). Participants were selected through community outreach efforts to ensure a diverse sample. Efforts were made to include participants from various backgrounds to enhance the generalizability of the findings. The sample size of 80 was selected to detect meaningful differences between the groups, while considering the practical constraints of the study.

The age groups were selected to represent a comprehensive spectrum, from children to elderly adults, reflecting a full range of cognitive development and decline. This approach was intended to provide a clear view of memory retention across the lifespan. Very young children were excluded from the study as they may have struggled with writing or complex recall tasks, which could skew the results. This age selection was influenced by various research papers on memory retention, which categorize individuals into age groups based on cognitive abilities and memory capacity at different life stages (Alloway & Alloway, 2013; Brehmer et al., 2007; Fitzgerald & Lawrence, 1984). Additionally, the selected age ranges minimize significant cognitive differences within each group, ensuring that any observed effects reflect typical developmental stages, rather than extreme variations. This also strengthens the reliability of the study, as it allows for more consistent comparisons across groups.

Informed Consent and Ethical Considerations

Prior to participation, all potential participants and their legal guardians (for minors) were provided with information about the study's objectives and procedure. Informed consent was obtained from all participants or their legal guardians before data collection began. The study adhered to ethical guidelines for research involving human participants, ensuring confidentiality and privacy throughout the study. All data were handled securely, and participants were assured of their right to withdraw from the study at any time without penalty.

Experimental Procedure

Each participant was administered the memory tests individually in a quiet, distraction-free environment to minimize external influences on performance. The order of stimulus presentation (pictures versus words) was counterbalanced across participants to control for order effects. Participants studied each stimulus for 30 seconds before being asked to recall as many stimuli as possible. They could either verbally state their responses or write them down, depending on their age and preference.

Memory Score Calculation

Memory performance was evaluated based on the number of correct items recalled by each participant. To calculate the memory score, participants first viewed the stimulus (either pictures or words) for 30 seconds. After the presentation, they were asked to recall and list as many stimuli as they could remember. The scoring process involved awarding 1 point for each correct recall, while incorrect or omitted responses received a score of 0. The total memory score for each participant was determined by summing the points for all correct recalls.

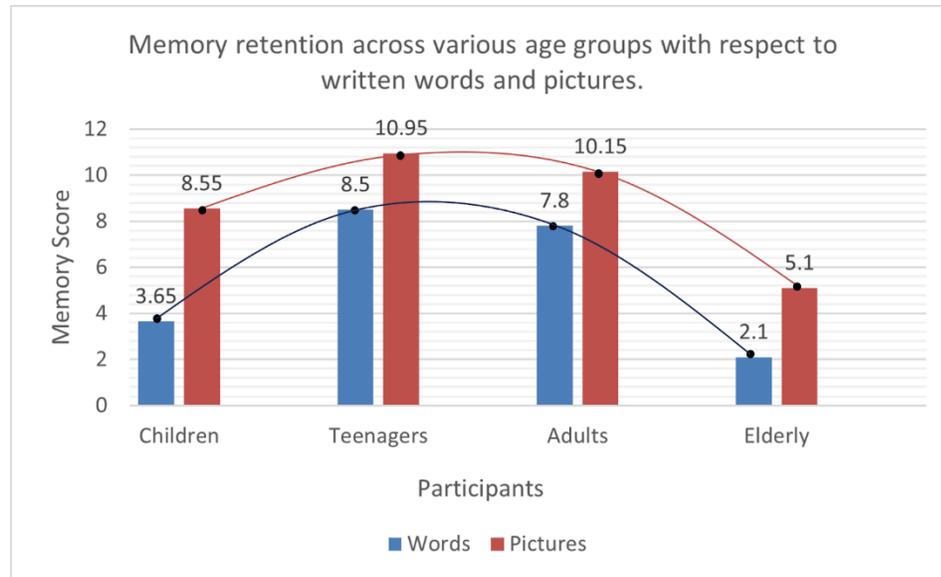
Data Analysis

Descriptive statistics, including means and standard deviations, were calculated for memory performance scores across different age groups and stimuli types to summarize the data and identify general trends in memory retention. Additionally, inferential statistical analyses, specifically t-tests and p-values, were conducted to determine whether the observed differences in memory retention between age groups and stimuli types were statistically significant.

Results

Age Group	Stimulus Type	Mean Memory Score	Standard Deviation	T test	P value
Children	Pictures	3.65	1.0399	-12.60	3.87×10^{-15}
	Words	8.55	1.51186		
Teenagers	Pictures	8.5	0.94591	-8.45	2.96×10^{-10}
	Words	10.95	0.88704		
Adults	Pictures	7.8	1.00525	-6.49	1.19×10^{-7}
	Words	10.15	1.3562		
Elderly	Pictures	2.1	1.16529	-7.843	1.83×10^{-9}
	Words	5.1	1.25237		

TABLE 1: Memory performance scores (Mean and Standard Deviations) across different age groups



GRAPH 1: Memory retention across various age groups with respect to written words and pictures

The results from the memory test data highlight notable differences in memory retention across various age groups with respect to written words and pictures as depicted in table 1 and graph 1.

Younger Children (Ages 5-12)

Younger children showed better recall for pictures (8.55 ± 1.51) compared to written words (3.65 ± 1.04). The statistical analysis using the t-test indicated a highly significant difference between the recall of pictures and written words ($t = -12.60$, $p = 3.87 \times 10^{-15}$), confirming that visual stimuli are more effectively retained at this developmental stage. This aligns with cognitive development theories indicating that children in this age range often rely more on visual information for learning and memory. Research supports the picture superiority effect, which suggests that pictures are generally better remembered than words due to their ability to evoke stronger associations and facilitate deeper processing (Paivio, 1986; Mayer & Moreno, 2003).

Additionally, studies have demonstrated that younger children benefit significantly from pictorial stimuli, as these images enhance memory retention and engagement compared to text alone (Defeyter, Russo, & McPartlin, 2009). This reliance on visual information can be attributed to their developing cognitive structures, which are better suited for processing images during learning tasks (Gualtieri & Finn, 2022).

Teenagers (Ages 13-19)

Teenagers exhibited strong memory performance for both written words (8.50 ± 0.95) and pictures (10.95 ± 0.89), with a slight preference for pictures. The t-test outcome ($t = -8.45$, $p = 2.96 \times 10^{-10}$) reflects a statistically significant difference, suggesting that although teenagers can effectively process both types of stimuli, visual information still holds a slight advantage. By this stage, cognitive processes are more developed, allowing for efficient encoding and retrieval of both types of stimuli. The preference for pictures may be influenced by their earlier developmental experiences and ongoing reliance on visual cues (Fleming & Mills, 1992; Radvansky et al., 2022).

Research supports the idea that as teenagers mature, their cognitive abilities allow them to leverage both pictorial and textual information for better memory performance. For instance, studies have shown that adolescents are particularly adept at recognizing and recalling images, which can evoke stronger associations compared to words alone (Brady et al., 2008). This aligns with the picture superiority effect, where pictures are generally remembered better than words, particularly in individuals with more developed cognitive processes (Paivio, 1986; Mayer & Moreno, 2003). Moreover, the ability of teenagers to efficiently encode and retrieve information from both written words and pictures can be attributed to their enhanced working memory capabilities during this developmental stage (Forsberg, Adams, & Cowan, 2023). This suggests that educational strategies incorporating both types of stimuli may further optimize learning and memory retention in adolescents.

Adults (Ages 20-60)

Adults demonstrated effective memory retention for both written words (7.80 ± 1.01) and pictures (10.15 ± 1.36), with a slight advantage for pictures. The t-test ($t = -6.49$, $p = 1.19 \times 10^{-7}$) points to a meaningful difference in recall performance between the two types of stimuli, highlighting that adults are capable of efficiently processing both verbal and visual information. This suggests that adults possess a well-rounded ability to process various types of information, with the integration of visual and verbal information enhancing memory through sophisticated cognitive strategies such as dual coding (Paivio, 1979; 1986).

Research indicates that adults can leverage their cognitive resources to optimize memory retention across different modalities (Mayer & Moreno, 2003). The ability to efficiently encode and retrieve both written and pictorial information reflects the advanced cognitive processes that develop through experience and education. Moreover, the slight preference for pictures among adults may be attributed to their inherent advantage in evoking stronger associations and facilitating deeper processing, which are critical for effective memory retention (Schacter, Israel, & Racine, 1999). This aligns with findings that suggest adults'

cognitive strategies, including the use of imagery and visualization techniques, contribute to enhanced memory performance in tasks involving both words and pictures (Mayer, 2020).

Elderly (Ages 61 and Above)

Elderly participants in this study demonstrated significantly better recall for pictures (5.10 ± 1.25) compared to written words (2.10 ± 1.17). The t-test findings ($t = -7.843$, $p = 1.83 \times 10^{-9}$) reveal a significant gap in recall between the two types of stimuli, reinforcing that visual memory remains relatively intact even as verbal memory declines with age. This finding highlights the cognitive changes associated with aging, such as reduced processing speed and working memory capacity, which can hinder the recall of written information (Murman, 2015). Despite these challenges, older adults tend to perform better with pictures, as the richness and distinctiveness of pictorial information enhance memory retrieval. The distinctiveness of pictures allows for more effective encoding and retrieval, making them a valuable tool for improving memory performance in older adults. Additionally, studies have supported the notion that pictorial stimuli play a crucial role in enhancing recall in this demographic. (Forsberg, Johnson, & Logie, 2020).

The findings indicate that memory retention is influenced by both age and the type of stimulus, with younger children and elderly individuals demonstrating better performance with pictures. Teenagers and adults, on the other hand, show effective memory retention for both written words and pictures, although there is a slight preference for pictures.

The results revealed a bell curve pattern (graph 1) in memory retention across different age groups. Younger children and elderly participants exhibited lower memory scores compared to teenagers and adults, regardless of whether the stimuli were written words or pictures. This trend suggests that memory performance follows a developmental trajectory, with greater challenges in memory retention at both ends of the age spectrum. Overall, the results highlight the developmental and compensatory aspects of memory throughout the lifespan, emphasizing the importance of pictorial stimuli in enhancing recall for younger and older populations (Hockley, 2008; Defeyter, Russo, and McPartlin, 2009).

Summary

The results indicate a strong positive correlation between memory performance for words and pictures across all age groups, with correlation coefficients ranging from 0.727 to 0.90. All correlations are statistically significant, with p-values well below 0.05, indicating a strong relationship between the two stimulus types. The t-test results reveal significant differences in memory performance between words and pictures across all age groups, with highly negative t-values (-6.49 to -12.60) and extremely low p-values (ranging from 1.19×10^{-7} to 3.87×10^{-15}), suggesting that

participants consistently performed better on picture-based memory tasks than word-based tasks.

Comparative Analysis

Pictures vs. Written Words in Memory Recall

The distinction between pictorial and textual stimuli in memory retention has been a central theme in cognitive psychology. Numerous studies have established that pictures are generally better remembered than written words (Paivio, 1986; Mayer & Moreno, 2003). This effect is robust across various age groups and contexts, indicating that pictorial information engages more cognitive resources and facilitates deeper processing.

In my study, younger children (ages 5-12) showed better recall for pictures (8.55 ± 1.51) compared to written words (3.65 ± 1.04). This finding aligns with the established literature on the PSE, suggesting that children rely heavily on visual information for learning due to their developing cognitive structures (Gualtieri & Finn, 2022; Whitehouse, Maybery, & Durkin 2006). Similarly, elderly participants (ages 61 and above) displayed better recall for pictures (5.10 ± 1.25) than for written words (2.10 ± 1.17), reinforcing the idea that pictorial memory remains relatively intact in older adults, even as verbal memory declines (Murman, 2015; Forsberg, Johnson, & Logie, 2020). Research shows that picture stimuli often lead to more elaborate encoding than textual stimuli. Hockley (2008) demonstrated that participants had a greater hit rate for picture pairs compared to word pairs in associative recognition tasks.

However, some studies have found contradictory results. Amrhein, McDaniel, & Waddil (2002) suggested that when responses were pictures, learning was much slower, and words produced faster responses than pictures. Similarly, Weldon and Roediger (1987) found that altering retrieval demands reversed the PSE. These findings could be due to the use of different experimental manipulations, such as response time deadlines and retrieval demands, which may have influenced the PSE. Snodgrass and McCullough (1986) argued that the advantage of pictures over words is only evident when visual similarity is a reliable cue because it takes longer to understand pictures than words. This suggests that the PSE may be more pronounced when visual similarity is a salient factor, which was not explicitly manipulated in my study. Postman (1978) reported a reverse PSE, where learning was much slower when the responses were pictures compared to words. This contradicts my findings, but the difference could be due to the use of a learning paradigm in Postman's study rather than a memory recall task.

Although pictorial stimuli generally enhance memory retention, there are scenarios where text-based learning may be equally or more effective. Words can be more effective when deeper semantic processing is required, such as in subjects that rely heavily on abstract concepts or detailed

explanations (e.g., advanced mathematics, philosophy, or law) (Craik & Tulving, 1975). The multimedia principle suggests that people learn better from words and pictures combined than from words alone, though the effectiveness of this combination depends on content, conditions, and individual differences (Fletcher & Tobias, 2005). Additionally, research has found that repeating targeted information in verbal captions can be as effective as pictorial illustrations in promoting text memory, indicating that redundancy in verbal encoding can support retention in ways similar to images (Daneman & Ellis, 1995). Furthermore, studies have demonstrated that the picture superiority effect can be eliminated when processing is deep and no memory test is expected, suggesting that attention allocation and semantic depth are critical in determining the effectiveness of different learning formats (Foos & Goolkasian, 2008).

Additionally, avid readers may prefer to learn through text due to their well-developed verbal processing skills and ability to construct mental representations from written material (Riding & Mathias, 1991). Research indicates that individuals with a strong preference for text-based learning experience lower cognitive load and higher comprehension when processing written information compared to other modalities (Lehmann & Seufert, 2020). Moreover, comprehension involves constructing a coherent mental representation that integrates textual information with prior knowledge, a skill that avid readers refine through frequent reading (Broek, 2010). The effectiveness of imagery-based strategies varies depending on content, as text is often more effective when dealing with abstract or complex concepts that are difficult to visualize (De Beni & Moè, 2003). For these learners, written content allows for greater cognitive flexibility in analyzing and interpreting complex information, particularly in domains that require deep semantic processing.

VARK Model: A Contradictory Framework

While my findings emphasize the superiority of visual stimuli over written words in memory recall, the VARK model presents a different view on learning preferences, suggesting that individuals learn best when instruction aligns with their preferred style, giving equal weight to all modalities (VAR, 2020). This contrasts with my findings, as the VARK model does not prioritize visual learning over other methods.

The VARK model helps individuals recognize their learning preferences, allowing them to choose the most effective study methods (Karim, 2014). It highlights the prevalence of multimodal learning, with 66% of participants preferring multiple styles, including bimodal (20.1%) and trimodal (15.0%) approaches (VAR, 2020). Learners often combine styles such as visual, auditory, and kinesthetic based on the task (Karim, 2014).

Moreover, VARK shows that Kinesthetic is the most common single learning preference at 23.2%, while Visual ranks lowest at 1.9%. This suggests that many learners may not respond as well to visual stimuli as

my findings suggest, underscoring the need for individualized approaches to learning (Karim, 2014).

The strong memory retention benefits observed with pictures in this study align closely with VARK's visual learner category, suggesting that individuals who favor visual input may indeed experience enhanced recall with imagery-based learning. However, for reading/writing learners, my findings suggest that while text-based learning can be effective, it is particularly beneficial in contexts requiring deep semantic processing, such as abstract reasoning or technical subjects (Craik & Tulving, 1975). This nuance is not explicitly accounted for in the VARK model, which categorizes learning preferences without directly addressing how different stimuli influence memory retention.

Furthermore, the VARK model includes auditory and kinesthetic learners, but my study did not assess these modalities. While auditory learners may benefit from verbal instruction and kinesthetic learners from hands-on activities, their memory retention patterns compared to visual and textual stimuli remain an open question. Notably, VARK data indicate that Kinesthetic is the most common single learning preference at 23.2%, while Visual ranks lowest at 1.9% (Karim, 2014). However, my study demonstrates that pictures consistently enhance memory retention across all age groups, regardless of self-reported learning preference. This suggests that while individuals may express a preference for certain learning styles, actual memory performance is more closely tied to cognitive processing mechanisms rather than subjective learning preferences, reinforcing the argument made by Pashler et al. (2008).

Age-Related Changes in Memory

The analysis of age-related changes in memory retention reveals a bell curve pattern, consistent with findings from various studies. In my results, younger children and elderly participants exhibited lower memory scores compared to teenagers and adults, regardless of whether the stimuli were written words or pictures. This trend aligns with cognitive development theories, which suggest that memory capabilities evolve through distinct stages of life (Murman, 2015; Gualtieri & Finn, 2022). In my study, younger children showed a pronounced preference for pictures, as indicated by their significantly higher recall for pictures compared to words. Similarly, elderly participants recalled pictures more effectively than words. This suggests that while younger children are still developing their cognitive abilities, older adults may rely on pictorial memory as a compensatory mechanism due to declines in textual processing (Forsberg, Johnson, & Logie, 2020). Young children's brains have high neural plasticity, which enhances their ability to encode new information efficiently (Johnston, 2009). This plasticity supports visual learning, aligning with their higher recall for pictures.

The bell curve observed in my results highlights the developmental trajectory of memory retention, where memory performance peaks during adolescence and early adulthood before gradually declining in later years. This decline is often attributed to decreased processing speed and working memory capacity in older adults (Salthouse, 1996). During adolescence and early adulthood, working memory, processing speed, and executive function are at their peak (Luna et al., 2004). This explains why both text and pictures are effectively retained during these years. As people age, hippocampal atrophy, reduced synaptic plasticity, and slower neural processing contribute to memory decline (Bettio, Rajendran, & Gil-Mohapel, 2017). Older adults often compensate by relying more on semantic memory (e.g., prior knowledge) rather than episodic memory (new information recall).

The findings support the notion that memory performance is not static but rather fluctuates across the lifespan, influenced by both cognitive development and aging processes (Radvansky et al., 2022). The medial temporal lobe, crucial for episodic memory, is more engaged when processing visual stimuli than text (Grady et al., 1998). Since semantic processing declines more slowly than episodic memory, older adults may retain pictures better because they activate associative memory networks (Naveh-Benjamin et al., 2003).

However, some studies have found contradictory results. Defeyter, Russo, and McPartlin (2009) found that while younger children could recognize pictures, their performance lagged behind that of older participants, contradicting my findings. This difference could be due to the use of a recognition task in the Defeyter, Russo, and McPartlin (2009) study versus a recall task in my study. Recognition tasks may be less sensitive in detecting the PSE in younger children. Jenkins, Neale, & Deno (1967) reported a reversed PSE in second-grade students, where words were better recalled than pictures in a free recall task. This is in contrast to my finding of younger children's preference for pictures. The difference could be attributed to the use of free recall, which may be more challenging for children compared to the recall task used in my study. Additionally, Jenkins, Neale, & Deno (1967) speculated that children may find spelling words difficult, but when they had viewed the word earlier, the spelling was primed, making it easier to output the word than the picture.

Discussion

The findings from this study highlight the complex relationship between age, learning preferences, and memory retention, specifically when comparing reading words versus viewing pictures. This focus goes beyond general comparisons of visual and verbal stimuli to examine specific methods of content delivery.

Potential biases may have influenced the results, particularly individual differences in prior exposure to images versus text. Participants

with greater familiarity with visual media may have shown an enhanced recall for pictures, while avid readers may have retained written words more effectively. Additionally, variations in educational background and cultural emphasis on either textual or visual learning could have contributed to differences in memory performance. While randomization of stimuli helped mitigate some of these biases, future research could incorporate pre-tests or participant questionnaires to better control for prior exposure.

The results show significant age-related differences in memory performance. Younger children and elderly individuals had better recall for pictures compared to written words, which aligns with the picture superiority effect. This effect suggests that images are more memorable because they evoke stronger associations and facilitate deeper processing (Schacter, Israel, & Racine, 1999; Brady et al., 2008). In contrast, teenagers and adults showed good memory retention for both written words and pictures, though they slightly preferred pictures. This can be explained by the more developed cognitive processes in these age groups, which allow for efficient encoding and retrieval of different types of stimuli. The bell curve pattern observed in memory performance across age groups suggests that memory peaks during adolescence and early adulthood, then gradually declines with age. This decline is often linked to slower processing speed and reduced working memory capacity, which can affect the recall of written information (Murman, 2015).

The findings emphasize the important role pictures play in memory retention, especially for younger children and older adults. For younger children, this reliance on pictorial stimuli likely reflects their developing cognitive structures, which are better suited to processing images. In older adults, the preference for pictures may help compensate for cognitive decline, enhancing memory retrieval. Research has shown that older adults often focus less on visual details during memory encoding, leading to challenges in recalling text (Hasher & Zacks, 1988; Naveh-Benjamin, 2000). The richness and distinctiveness of pictures can boost memory retrieval, making them a valuable tool for improving recall in both younger and older populations. This is particularly important in educational settings, where incorporating visual elements can greatly enhance learning outcomes for people of different ages.

Educational Implications

The insights gained from understanding the differences in memory retention between pictorial and textual stimuli, as well as age-related changes, have significant implications for educational practices. Educators should consider the varying cognitive strengths and weaknesses of different age groups when designing instructional strategies. For younger learners, incorporating visual aids, such as pictures and diagrams, can enhance memory retention and engagement. The results of our study indicate that younger children benefit from pictorial stimuli, as their

cognitive structures are better suited for processing images (Gualtieri & Finn, 2022). For adolescents and adults, a combination of visual and verbal information is recommended, while for older adults, educational strategies that leverage pictorial memory and minimize reliance on written information may improve learning outcomes (Murman, 2015).

Moreover, the findings suggest that educational assessments should account for the differences in memory performance across age groups. Recognition-based assessments may be more suitable for older adults, while recall tasks could be more appropriate for younger students (Radvansky et al., 2022). Incorporating multimodal teaching approaches that combine pictorial and textual elements can cater to diverse learning preferences and enhance overall memory retention across age groups (Fleming & Mills, 1992).

However, implementing visual-based learning strategies in real-world settings presents several challenges. First, learner preferences and cognitive styles vary significantly, meaning that some students, particularly those with strong verbal processing skills, may find text-based learning more effective (Riding & Mathias, 1991). Second, resource constraints in educational institutions may limit access to high-quality visual materials, especially in underfunded schools (Fadilah, 2023). Developing effective visuals also requires time and expertise, which may not always be available (Fadilah, 2023). Over-reliance on visuals without accompanying verbal reinforcement may result in passive engagement rather than deep learning (Naps et al., 2003). Furthermore, assessment challenges arise as traditional standardized tests are predominantly text-based, which could disadvantage students who rely heavily on imagery for learning (Zydney, Hord, & Koenig, 2020).

In line with these insights, the VARK model can be implemented to assess and address individual learning preferences, thereby enhancing engagement and retention by aligning instructional strategies with preferred learning modalities. Additionally, further research is recommended to explore other factors influencing memory retention, such as educational background and socio-cultural influences. Expanding studies to include diverse populations and contexts, and exploring interventions and technologies to support memory retention and cognitive health, would further inform and refine educational practices. By adapting educational practices to align with cognitive development and memory research, educators can foster more effective learning environments tailored to the needs of different age groups.

Conclusion

The findings of this comprehensive study provide compelling evidence for the significant impact of age and stimulus type on memory retention. The results unequivocally demonstrate the superiority of pictorial stimuli over textual information in enhancing memory recall, particularly for younger children and older adults. The observed bell curve pattern in memory

performance across age groups further reinforces the notion that cognitive abilities follow a developmental trajectory, with peaks during adolescence and early adulthood, and gradual declines in later years.

The findings underscore the importance of tailoring educational practices to align with cognitive development and memory research, ultimately fostering more effective learning environments that cater to the diverse needs of learners across the lifespan. These findings have profound implications for educational practices, emphasizing the critical importance of incorporating visual aids and tailoring instructional strategies to the specific needs of different age groups. For younger learners, the incorporation of pictures and diagrams can significantly boost memory retention and engagement. Similarly, for older adults, educational approaches that leverage pictorial memory while minimizing reliance on written information may lead to improved learning outcomes.

The real-world applicability of these findings extends to various practical contexts, such as in educational settings and elder care facilities. For instance, in old age homes, memory-related interventions that utilize visual stimuli could be implemented to enhance daily navigation and cognitive engagement among elderly individuals. Similarly, incorporating more visual learning strategies in classrooms could support better retention and engagement in younger students.

The insights gained from this study serve as a robust foundation for future research needed to explore the specific mechanisms underlying age-related differences in memory retention. Future studies should investigate how different types of stimuli interact with cognitive processes across the lifespan, as well as the effectiveness of various instructional strategies in enhancing memory retention for diverse populations.

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