CURRENT MEDICINE

MIDITERRANEAN JOURNALS

Review

DOI: 10.55085/cm.2022.647

A Scoping Literature Review of Recall and Memory Psychometric Tools

Philip K Varkey [a,b,c], Zachary Isaac Merhavy [a,b,d], Kyle Simtion [a,b,e], John Varkey [a,b,f], Thomas C Varkey [a,b,g]

[a] The College of Education, The University of Texas at Austin, Austin Texas, USA.
[b] Dell Medical School, Department of Neurology, The University of Texas at Austin, Austin Texas, USA.
[c] The College of Science, Engineering, and Technology, Grand Canyon University, Phoenix, Arizona, USA.
[d] Ross University School of Medicine, Bridgetown, Barbados, USA.
[e] DeBusk College of Osteopathic Medicine, Lincoln Memorial University, Harrogate, Tennessee, USA.
[f] The College of Engineering, University of Notre Dame, Notre Dame, Indiana, USA.
[g] The Colangelo College of Business, Grand Canyon University, Phoenix, Arizona, USA.

Received: 02 Mar 2022;
Revised: 28 Mar 2022;
Accepted: 01 Apr 2022;
Published: 12 Apr 2022

Academic Editor:
Mohamed Soliman

Correspondence: Thomas C Varkey, The College of Education, The University of Texas at Austin, Austin Texas, USA.
Email: thmsvrk7@gmail.com

Cite this article as: Varkey PK, Merhavy ZI,Simtion K, Varkey J, Varkey TC. A Scoping Literature Review of Recall and Memory Psychometric Tools. Curr Med. 2022;1:647. [https://doi.org/10.55085/cm.2022.647]

Authors' contributions
The participation of each author corresponds to the criteria of authorship and contributorship emphasized in the Recommendations for the Conduct, Reporting, Editing, and Publication of Scholarly work in Medical Journals of the International Committee of Medical Journal Editors. Indeed, all the authors have actively participated in the redaction, the revision of the manuscript, and provided approval for this final revised version.

Funding
No funding was received from any organization to conduct the present study.

Acknowledgments
Dr. Seung Choi for his work, kindness, and mentorship in the initial drafts and some critical feedback as the paper underwent several revisions. Thomas and Rhonda Varkey for grammar and editing work to ensure proper flow and ensure the readability of the different drafts. Elliot and Teresa Frohman for their constant encouragement of the team and discussions of these tests and how important they can be in keeping the patient at the heart of the work.

Conflict of interest
The authors declare that there is no conflict of interest regarding the publication of this article.

ABSTRACT

Aim: This scoping literature review aims to determine what is known about 1) the method of testing memory for both long-term and short-term memory and 2) determine which of these methods may be useful in testing the memory.
Background: Several cognitive domains are actively utilized in basic adult activities of daily living (ADLs). These can and are often tested by different cognitive batteries and are necessary to test for patients to receive social support funds and access to programs.
Methods: The study follows the established methods for a scoping literature review with guidelines to identify memory tests, their validity within the field, and the different test limitations within its major age demographic. The article restricts its research to articles published between 1985 to 2021 published quantitative and qualitative primary studies, evaluation research, and systematic and other types of reviews are included if they address different cognitive and memory abilities along with different memory test applications and their use within different major age demographics, and they are published in English.
Results: The combined search strategy yielded 93,000 articles, of which 88 are included. The use of different memory tests in the major age demographics (pediatrics, adult, and geriatrics) was evaluated, and the findings from the different articles were summarized in written form and a table.
Discussion: These 88 peer-reviewed sources were utilized to develop this scoping literature review on the current standard assessment tools for measuring the psychometric properties of memory, recall, and learning.

Keywords: Memory, Recall, Learning, Standardized Examinations, Social Security, Pediatric Assessments, Geriatric Assessments, Adult Assessments.

1. INTRODUCTION

Memory and recall of basic facts and figures are necessary requirements in many major fields, from medicine to automotive repair [1-4]. Regardless of the sensical behavior of the systems or processes, many of the ideas, numbers and normal ranges of values that are presented must be remembered through memorization or familiarization with these figures to the ideal or normal presentation [1-4]. The main examination physicians are tasked with passing is the United States Medical Licensing Examination, or USMLE, which is separated into three parts known as Step 1, Step 2, and Step 3, taken over several years [100 – 101]. These and other standardized examinations such as the Scholastic Aptitude Test (SAT), the State Bar Examination, and Graduate Record Examination (GRE) exist because colleges, universities, scholarship committees, graduate schools, and accreditation boards place a heavyweight on performing well on such exams [100]. As a result, society has seen the rise of an entire industry in helping students to do so [102-103].

The industry includes companies that sell books, courses, or programs of study which claim to have similar practice problems, will be able to "increase your score by --- points," or have mastered the tools to do well regardless of the level of baseline knowledge [102-103]. While many of these organizations often reteach material to the students by employing many rigorously studied tactics such as sequential learning, desirable difficulties, productive failures, multimedia principles, and self-regulated learning [5-7], these are not the only methods used [8-10]. Many tactics not listed above, which these agencies and organizations utilize, are based on anecdotal evidence without rigorous psychometric testing of the effectiveness of such memory devices and techniques [8-10]. This is not to say that these tools might not also be as effective as teaching and tutoring tools for increasing the level of learning, memory, or recall. Nevertheless, without proper scientific investigation, it is impossible to determine the effectiveness, utility, and proper context for the utilization of these tools.

Therefore, the question raised revolves around understanding what the current methods for measuring recall in psychometrics are and which of these may be useful in testing the memory devices and techniques utilized to improve scores on these standardized examinations. This paper will provide the major memory, learning, and recall tools that have been verified in literature and will compare their utility for different purposes and populations.

2. METHODS

The study follows the established methods for a scoping literature review [104] with guidelines to identify memory tests, their validity within the field, and their different limitations within each test's respective major age demographic. Published quantitative and qualitative primary studies evaluation research and systematic and other types of reviews were included if they addressed different cognitive and memory abilities along with different memory test applications and their use within different age groups, and they were published in English.

Three databases, GoogleScholar, Cochrane, and Medline, were searched from 1985 to 2021 using mesh headings and free-text keywords that were applicable in combination with Boolean operators "AND" and "OR." The major keywords utilized were "Memory," "Recall," "Test," "Adult," "Pediatrics," or "Geriatric." Each of the articles selected was evaluated by two researchers, and disagreements were resolved with a vote by the five total researchers. Articles were excluded if they were not full text available for free, if they were not written in the English language if they were not peer-reviewed, and if the articles were older than 1985. Papers were also excluded if they merged two of the three stated age groups utilized in the study (pediatrics, adults, or geriatrics) or if they covered all three age demographics using a singular test.

3. RESULTS

The combined initial search resulted in 93,000 articles, of which only 88 were included based on the search and inclusion/exclusion criteria mentioned above. These articles discussed the biological mechanisms of memory and recall and cognitive testing of the different demographic areas of pediatrics, adults, and geriatric patients. The uses of the different tests, the biological mechanisms of the disease, and the different limitations of this scoping literature are all described below, along with novel tables which separate the different psychometric tests based on the three age demographics.

4. DISCUSSION

The current understanding of memory, learning, and recall is based on the biological processes of the limbic system [11]. The limbic system, otherwise known as the limbic lobe, has been described in detail in the literature [11]. This portion of the neural anatomy has been implicated in memory formation, processing of emotions, and the fight or flight mechanism [11]. Abnormalities in the activation, processing, feeding of vital nutrients and cofactors, and connectivity of different groups of neurons within the circuitry have been linked to different bio-pathophysiological disease states within the individuals inflicted with the ailment [11].

4.1. The biological basis of memory in the hippocampus and the amygdala

Over the last several decades, new data has emerged that places the amygdala, once considered to only control the fight or flight center, into the limelight as a necessary and vital portion of the memory creation process with the classical center of memory formation that is the hippocampus [12-13]. This is further supported as novel ideas, words, and other statements, including dirty words or cursing, utilize both centers to create new memories [11, 14-16]. The linkage between the autonomic nervous system and the memory centers of the brain is made clear in both the literature [11, 14-16] and the personal experiences of the authors who took standardized tests such as the SAT, GRE, and MCAT as a part of their education.

Remote memory involves recollection of aspects involving the past, and its processing can be very complex, involving multiple sections of the brain such as the hippocampus and cortex [17]. The hippocampus, specifically, helps with the retrieval and reconstruction of long-term memories stored in different areas of the cortex [17]. Remote memory has also been shown to affect working, or immediate, memory and may therefore play a significant role in the development of immediate recollection processes [17]. The most interesting aspect of long-term memory is how it is maintained over such long periods of time. Many different synapses play a role in how memory is maintained; however, these neurons require certain signaling to function. Specifically, the continuous activity of Arp2/3 in the lateral amygdala is essential for the maintenance of remote memory [18]. Arp2/3 works by maintaining the action required for the cytoskeletal network involved in the formation of this memory network [18].

One final aspect that must be considered is the different areas of the brain that are used during the tests. In an overview of computer neural networks and their relation to the human brain, human memory is separated into areas within the brain; the hippocampus, which has been previously mentioned, and the neocortex, which uses episodic and slow memory, respectively [19]. Due to this, many memory tests are designed with the intent to see what an individual can recall using their slow memory. If done properly, then signs of dementia and other diseases can be determined effectively and could potentially provide better support for tested individuals [19]. This can be further validated by how memory is recalled, as it has been shown that retrieving more difficult information results in greater cognitive ability [20]. Although some aspects may be subject to debate, this shows that certain memory tests are designed to rely more so on patterns and large memory retrieval rather than the use of different aspects of memory [20]. Having reviewed, at a cursory level, parts of the relevant neural anatomy, it behooves the reader to now look at the current psychometric tools in use with different patient populations.

4.2. Current psychometric tools

Cognitive function testing is an area of controversy within the academic space and is often associated with deep societal fear [21-23]. Due to the feared social consequences of the results of these tests (i.e., labeling, loss of opportunities, and/or potential institutionalization caused by a potential perceived inability to care for one's own needs for daily living [21-23], many avoid testing, which can lead to further complications as various diseases or medical issues continue to mount. This neuropsychological battery of testing is often employed on individuals when they are either selected to be tested as a result of dysfunction in the classroom as children, as a return to work fitness of duty examination after a prolonged leave of absence and/or due to consequences as a result of a disease state, as seen in instances of multiple sclerosis or stroke which help determine the eligibility for social services from either the state or federal governments [24-27].

Within the psychological construct of cognitive functioning, there are several domains, including general cognition/intellectual ability, language and communication, learning and memory, attention and vigilance, processing speed, and executive functioning [21-23]. Within the literature on cognitive functioning, there are several different tools that can be utilized to measure a person's cognitive functioning. These tools have been verified both through rigorous sampling as well as through verification of the data by different members of the American Academy of Clinical Neuropsychology (AACN), Division 40 of the American Psychological Association (APA), and the National Academy of Neuropsychologists (NAN) [28-29].

4.3. Cognitive functionality batteries

While this literature review focuses on the specifics of the measurement of learning, recall, and memory, these are often tested as part of larger cognitive functional batteries [28-31]. These larger cognitive batteries are designed around the United States Social Security Administration's (SSA) criteria for determining a person's disability and, as a result, their ability to receive resources from the SSA's funding [28-31]. These tests cover all the domains listed previously. They often take at least one day for proper engagement, allowing the provider and the governmental agencies to have a large pool of data about the individual in order to make decisions regarding the level of disability (or ability) and giving the provider (i.e., physician, nursing practitioner, and/or physician's assistant), who ordered the testing, the necessary information to make a diagnosis and begin treatment [28-31]. With the nature of this testing mainly used for suspected disability, many external co-founders that are not pertinent to the researchers' questions are placed into the same group as the researcher's different interventions to increase memory, learning, or recall abilities [28-31]. Therefore, an abbreviated test that can be utilized in a short period to test the learner's memory, recall, or learning abilities is necessary.

4.4. Short domain specific testing for adults

Within each of these batteries of tests, there are multiple smaller portions that measure the domains instead of the entire cognitive function. Cognitive functionality testing, according to several organizations, can take upwards of nine hours, not including breaks [30-31]. Thus, a specific test that measures the domains of memory and learning is what this paper aims to evaluate for eventual use outside the realm of cognitive functionality in testing the effectiveness of interventions. Due to a lack of appropriate and rigorous scientific testing, many interventions remain only anecdotally effective for patients and students in improving memory [105]. Therefore, there is a great need for specific standards to be implemented to measure these cognitive function domains.

According to the current literature, there are three major domain-specific evaluations which are stand-alone tests that can be used for measuring the function memory and learning within an individual - the Rey Memory for Fifteen Items Test (RMFIT), the Word Memory Test (WMT), and the Test of Memory Malingering (TOMM) [30-31]. These tests seek to measure memory functions, including short-term and long-term memory; immediate, recent, and remote memory; memory span; retrieval of memory; remembering; and functions used in recalling and learning [32]. This definition from the World Health Organization (WHO) is like that laid out by Atkinson & Shiffrin (1968) and Tulving (1987; 1992), who agreed that memory consists of multiple sub-functions, including short-term memory, long term memory, working memory, sensory memory, procedural memory, and declarative memory [33-35].

Currently, the RMFIT, the WMT, and the TOMM are used to diagnose learning disorders and evaluate memory functionality in individuals, usually after physical injury or bio-pathophysiological disease processes. However, these tools and expansions of these tests need not only be used in this manner but have been used to measure memory function and changes in said functionality in fully intact adults [27, 36, 38]. Since these tools can be used to measure changes in the person's ability to recall information, both short-term and long-term, this means that these tools can be utilized in studies that look to measure the effects of different learning devices [27, 36, 38]. The other major benefit of utilizing these tools is that there is substantial data that demonstrates that these tools are valid measures of the psychological constructs of learning, recall, and memory [36-38]. Table 1 provides the various tests, times, and cofounders for adults.

4.5. Comparison and contrast of utility of the psychometric tools

The RMFIT, the WMT, and the TOMM are all validated within the American adult population [30, 37-38] and can be used with major assumptions that individuals tested have an average intelligence quotient of 100, that they are neurologically intact, and that other medical or psychological disorders are not to blame for their changes in memory which is assumed in many medical cases. As these constraints are placed on the test at a baseline, the ability to use these three tests of memory for the adult learner population is within normal utilization of these specific memories, learning, and recall measurement tools [30, 37-38]. While several explanations exist for changes within the individuals who demonstrate this effect, the authors believe that much of this might be due to the well-studied and well-documented Hawthorne effect [39-42], which was shown to be a major factor in improving the cognitive function of individuals with the Alzheimer's diagnosis in a study performed in 2007 [43]. The Hawthorne effect occurs when an individual or test group alters their behaviors, such as recalling various items from the norm [39-43].

4.6. Pediatric memory, learning, and recall assessments

If the individual's age in question is below the age of 18, then other cognitive assessment batteries or domain-specific tests would need to be utilized [44-46]. This difference in testing requirements is due to differences in the myelination of the frontal lobe, which does not finish development until the individual's mid-twenties, with some minor variations depending on genetics, environmental influences, and medical and psychiatric conditions of the patient in question [44-46].

One of the tests that have been validated with multiple measurements in the pediatric population is the Test of Memory and Learning (TOMAL) [47]. The TOMAL's validity has been shown in many studies, including one which used the test's visual and verbal questions with the subjects' memories being stretched over a 60-minute period [47]. The test presented the overall change in memory for adolescents and provided insight into further use for determining cognitive ability for adolescents, including determination of overall cognitive ability and any discrepancies [48]. Table 2 provides the various tests, times, and cofounders for pediatrics.

Table 1: Adult Memory Tests.

Test Name	Age Group	Test Length	Utility	Confounders
Rey Memory for Fifteen Items Test (RMFIT)	Adult	15 minutes	● Measures short-term, long-term, immediate, recent, and remote, memory span, retrieval of memory, remembering, and functions used in recalling and learning. ● Also used to diagnose learning disorders and evaluate the functionality of memory after physical or biopathophysiological injury. ● Can be used to measure the effects of different learning devices.	● Assumes that the individuals have an average high intelligence quotient of 100 and that medical or psychological disorders are not to blame for changes in memory.
Wechsler Memory Scale – Fourth UK Edition (WMC-IVUK)	Adult	75 minutes	● Assesses various memory and working memory abilities in individuals aged 16−90.	● Potentially contains suitability and fairness issues regarding testing 65−69-year-olds, re−testing examinees, and testing examinees with special needs.
Word Memory Test (WMT)	Adult	20 minutes	● Measures short-term, long-term, immediate, recent and remote, memory span, retrieval of memory, remembering, and functions used in recalling and learning. ● Also used to diagnose learning disorders and evaluate functionality of memory after physical or biopathophysiological injury. ● Can be used to measure the effects of different learning devices.	● Assumes that the individuals have an average high intelligence quotient of 100 and that medically or psychological disorders are not to blame for changes in memory.

4.7. Test of Memory Malingering (TOMM)

In 2005, the Test of Memory Malingering (TOMM) was verified within the pediatric population [49]. It was discovered that the test was able to correctly identify two individuals out of a sample of one hundred children between the ages of six and sixteen who were performing sub-optimally with regard to the cognitive domain of memory [49]. This finding was further supported in 2011, which found that the test was accurate with another sample of one hundred children aged five to sixteen [50]. Thus, based on these two validation studies, among others, the TOMM is another tool that can be utilized with the pediatric population in children as young as five years old [51-52]. As Ventura, DeDios-Stern, Oh, and Soble (2019) concluded at the end of their research study, the pediatric population is not simply made up of "little adults," and as a result, these validation studies must be performed on the TOMM to ensure that it was applicable to the population in question [88].

4.8. Other less utilized measures of pediatric memory, learning, and recall

While there have been several attempts and validated resources that have been created, nine (10) tests are most commonly used in both normal patient populations as well as in patients with Attention Deficit and Hyperactivity Disorder (ADHD), Traumatic Brain Injury (TBI), Autism Spectrum Disorder (ASD), epilepsy, and other specific learning disorders [53-56].

Table 2: Pediatric Memory Tests.

Test Name	Age Group	Test Length	Utility	Confounders
Child's Memory Scale (CMS)	Pediatric	30 minutes	● They are used as part of a standard psychological or neuropsychological evaluation in order to provide a comprehensive assessment of learning and memory in children and adolescents ages 5–16 years.	● Does not evaluate procedural memory. ● This test is unable to provide measures of long-term memory beyond a 30-minute period.
Everyday Memory Questionnaire (EMQ)	Pediatric	28 questions/no time limit	● Used in normal patients and those with ADHD, TBI, ASD, epilepsy, etc. ● Used to measure memory, learning, and recall.	
Everyday Verbal Memory Questionnaire (EVMQ)	Pediatric	28 questions/no time limit	● Used in normal patients and those with ADHD, TBI, ASD, epilepsy, etc. ● Used to measure memory, learning, and recall.	
Memory Self-Awareness Measure	Pediatric	20 minutes	● Used in normal patients and those with ADHD, TBI, ASD, epilepsy, etc. ● Used to measure memory, learning, and recall.	
Multidimensional Everyday Memory Ratings for Youth (MEMRY)	Pediatric	10 minutes	● Used in normal patients and those with ADHD, TBI, ASD, epilepsy, etc. ● Used to measure memory, learning, and recall.	
The Observer Memory Questionnaire – Parent Form (OMQ-PF)	Pediatric	27 items/No time limit	● Used in normal patients and those with ADHD, TBI, ASD, epilepsy, etc. ● Used to measure memory, learning, and recall.	
Parent Memory Questionnaire (PMQ)	Pediatric	28 items/No time limit	● Used in normal patients and those with ADHD, TBI, ASD, epilepsy, etc. ● Used to measure memory, learning, and recall.	
Prospective and Retrospective Memory Questionnaire (PRMQ)	Pediatric	16 items/No time limit	● Used in normal patients and those with ADHD, TBI, ASD, epilepsy, etc. ● Used to measure memory, learning, and recall.	

Questionnaire of Memory (Q-MEM)	Pediatric	40 items/No time limit	● Used in normal patients and those with ADHD, TBI, ASD, epilepsy, etc. ● Used to measure memory, learning, and recall.	
Test of Memory and Learning (TOMAL)	Pediatric	30 minutes	● Used to test the memory and cognitive ability of young children and adolescents.	
Test of Memory Malingering (TOMM)	Pediatric	15-20 minutes	● Measures short-term, long-term, immediate, recent, and remote, memory span, retrieval of memory, remembering, and functions used in recalling and learning. ● Also used to diagnose learning disorders and evaluate the functionality of memory after physical or biopathophysiological injury. ● Can be used to measure the effects of different learning devices.	● Assumes that the individuals have an average high intelligence quotient of 100 and that medically or psychological disorders are not to blame for changes in memory.
Working Memory Rating Scale (WMRS)	Pediatric	Up to 5 minutes	● Best option for looking at learning, recall, and memory. ● Available to the public. ● Has diagnostic utility across studies and has psychometric properties.	
Wechsler Intelligence Scale for Children	Pediatric	48 - 65 minutes	● Provides comprehensive information about the intellectual function, including verbal, visual-spatial, fluid reasoning, working memory, and processing speeds.	

These major measures of pediatric memory, learning, and recall are the Everyday Memory Questionnaire (EMQ), the Parent Memory Questionnaire (PMQ), the Prospective and Retrospective Memory Questionnaire (PRMQ), The Observer Memory Questionnaire – Parent Form (OMQ-PF), Working Memory Rating Scale (WMRS), Everyday Verbal Memory Questionnaire (EVMQ), Memory Self-awareness Measure, the Questionnaire of Memory (Q-MEM), the Wechsler Intelligence Scale for Children, and finally, the Multidimensional Everyday Memory Ratings for Youth (MEMRY) [57].

4.9. Working Memory Rating Scale (WMRS)

Of these assessments, the most well-validated for use in both neurologically intact individuals and individuals experiencing bio-pathophysiological disabilities is the 20-item version of the Working Memory Rating Scale (WMRS) [57-58]. The WMRS fulfills several of the criteria to establish itself as the best option for researchers looking at the learning, recall, and memory of the pediatric populations as it is first, available to the public; second, it has been shown to have diagnostic utility across studies; and third, has well-established psychometric properties (i.e., good test-retest reliability, good intercorrelation of items, internal consistency, etc.) [57, 59-64].

4.10. Geriatric Memory, Learning, and Recall Assessments

Memory in older individuals plays an important role in their ability to function in everyday life, and as a result, a decrease in memory implements challenges for the geriatric population [65]. One such area that can be negatively affected is the ability of individuals to verbally communicate, as a decrease in an individual's memory has been proven to cause difficulties in verbal fluency in patients who are at risk for mentally impairing diseases [65]. Prospective memory is another important cognitive function for older individuals, which allows them to remember things such as going to the grocery store for ingredients prior to cooking dinner. A decline in this type of memory can significantly affect their ability to function well in their everyday life [66]. Other factors that can affect memory in older adults are the development and progression of diseases such as Alzheimer's and dementia. They damage an individual's central nervous system (CNS) and thereby impact their cognitive function. Furthermore, the use of virtual reality memory testing has been shown to improve both short-term and long-term memory in elderly adults and those with memory impairment [67].

One of the most prominent determinants of the ability to mentally attain and temporarily store meaningful information is an individual's age utilizing their immediate memory [68]. A recent study on working memory found that as individuals continue to age, they experience a decrease in their ability to improve on mental tasks as well as the highest performance level they can achieve [68]. This furthers the idea that older individuals would have a slow rate of progress and performance than their younger counterparts [68]. Another determinant that must be discussed is the amount of information that an individual is attempting to process by utilizing their immediate memory. Even when regarding a single characteristic, a lower degree of precision is present when two items are remembered in tandem [69].

Within the geriatrics field, several tools are utilized when looking for mental disturbances [70-71, 96-97]. However, many of these tools are utilized for screening to identify mental disturbances that result from disease processes such as dementia. These tools include the Montreal Cognitive Assessment (MOCA), the Mini-Mental Status Exam (MMSE), the Verbal Fluency Test (VFT), the Sweet 16, the brief Fuld Object Memory Evaluation (OM), and the Mini-Cognitive Assessment [70-71] and Addenbrooke's cognitive examination III [96-97]. While all these tests are validated and well-studied in the geriatric population, the confines by which they were studied are limited only to screening for dementia and decreased mental functionality [70]. Table 3 provides the various tests, times, and cofounders for geriatrics.

4.11. Assessments for measuring average or above average memory

Since the RMFIT, WMT, and TOMM can be used for geriatric patients who are not being screened for dementia [30,37-38]. Thus, the three major tests can and should, be used due to the high levels of validation, their availability to the public, their diagnostic utility across studies, the high levels of internal consistency, good test-retest reliability, and good intercorrelation of items [30,37-38].

4.12. Other lesser utilized tests for use in the geriatric population

Outside of the assessments used for helping establish the diagnosis of dementia in geriatric populations and the tests that can be used for the general adult population, several other assessments have been validated for use [71-74]. These assessments include the Fuld Object Memory Evaluation (FOME), the Geriatric Evaluation by Relative’s Rating Instrument (GERRI), the Frontal Assessment Battery (FAB), and the EXIT-25 [71-74]. These lesser-utilized assessments are also used for gathering a baseline on the memory, learning, and recall of patients over the age of 65 years old [71-74].

Table 3: Geriatric Memory Tests.

Test Name	Age Group	Test Length	Utility	Confounders
EXIT-25	Geriatric	15-20 minutes	● Used for gathering a baseline on memory, learning, and recall in patients over 65.	● Designed with the median education level of a high school diploma, thus, any higher level of education will cause the results to be incorrectly skewed.
Frontal Assessment Battery (FAB)	Geriatric	10 minutes	● Used for gathering a baseline on memory, learning, and recall in patients over 65.	● Designed with the median education level of a high school diploma, thus, any higher level of education will cause the results to be incorrectly skewed.

Fuld Object Memory Evaluation (OM/FOME)	Geriatric	15 minutes	● Can find mental disturbances resulting from a disease process. ● Used for gathering a baseline on memory, learning, and recall in patients over 65.	● Only screens for dementia and decreased mental functionality. ● Those with a higher level of education will easily pass even with late-stage disease.
Geriatric Evaluation by Relative's Rating Instrument (GERRI)	Geriatric	20-30 minutes	● Used for gathering a baseline on memory, learning, and recall in patients over 65.	● Designed with the median education level of a high school diploma, thus, any higher level of education will cause the results to be incorrectly skewed.
Mini-Cognitive Assessment	Geriatric	3 minutes	● Can find mental disturbances resulting from a disease process.	● Only screens for dementia and decreased mental functionality. ● Those with a higher level of education will easily pass even with late-stage disease.
Mini Mental Status Exam (MMSE)	Geriatric	5-10 minutes	● Can find mental disturbances resulting from a disease process.	● Only screens for dementia and decreased mental functionality. ● Those with a higher level of education will easily pass even with late-stage disease.
Montreal Cognitive Assessment (MOCA)	Geriatric	10 minutes	● Can find mental disturbances resulting from a disease process.	● Only screens for dementia and decreased mental functionality. ● Those with a higher level of education will easily pass even with late-stage disease.
Sweet 16	Geriatric	2 minutes	● Can find mental disturbances resulting from a disease process.	● Only screens for dementia and decreased mental functionality. ● Those with a higher level of education will easily pass even with late-stage disease.
Verbal Fluency Test (VFT)	Geriatric	1 minute	● Can find mental disturbances resulting from a disease process.	● Only screens for dementia and decreased mental functionality. ● Those with a higher level of education will easily pass even with late-stage disease.
Addenbrooke's cognitive examination III	Geriatric	15 - 20 minutes	● Can be used to differentiate between Alzheirmer disease and fronto-temporal dementia	● Has yet to determine the impact of age, gender, I!, and education level on test results.

5. CONFOUNDING FACTORS

As stated in the previous sections of this literature review, many potential confounding factors can lead to a falsely elevated or minimalized score on the various tests of memory, recall, and learning [75]. These factors can be grouped into three broad categories: prior experience or education, pattern recognition, and pathophysiological changes [75]. Due to the high importance of these tests and their utility, it is paramount to ensure that these variables are accounted for [75]. Different sensory modalities, such as color, can also influence memory and the way in which individuals can utilize it and should be accounted for [75]. One study regarding visual components found that when items have the same color, they are processed far better by an individual than when each item has a different color. This can be attributed to the way in which the brain allocates different visual stimuli based on similarities [75].

5.1. Prior experience or education

Several of the methods used to examine the individuals require the ability to read and understand the words given to them [76]. One study found that the students who were able to read significantly well-outperformed students who read at an average or below-average level [76]. One of the other methods that were used to assess the individual's memory was only tested on college students, as this gave the facilitators of the test the ability to choose a variety of participants from different backgrounds [77]. Most of these cognitive assessments were created with the average education level of a high school diploma, and thus, those with a higher level of education would likely easily pass the dementia screening with late-stage disease, appearing as normal due to a large reserve in their memory, recall, learning, and cognitive reasoning functions [78]. This serves as a reminder that assessments are only useful for situations in which they were validated and a motivator to find better assessments. As a result, when trying to measure values that are normal or above average in the geriatric population, other measures must be utilized [70, 80].

As with the dementia screening tests, one of the biggest potential confounders for these tests is the fact that they were designed with the median education level of the United States in mind at the time of their creation, a high school diploma [79, 81]. As a result, any higher level of education or a level of education below that of an eighth-grade education will cause the results for that individual to be incorrectly skewed in one direction or another [79,81]. Additionally, the prior experience can, and often does, cause a fluctuation in the correct number of items answered on many of these tests of memory and recall [79], as prior exposure to similar items with feedback can act on the individual's learning as an unintentional spacing effect. As a result, it is imperative that these key pieces of information are collected before undergoing neuropsychiatric testing to ensure that the information gleaned from testing is useful and not confounded [79, 81].

Recent memory involves learning that corresponds to short-term information, and different factors play a role in how well an individual can utilize this recent or short-term memory [82]. A study involving musicians and individuals with dyslexia found that musicians perform far better than the control group at both low and high stimuli levels [82]. Subsequently, individuals with dyslexia had a far lower performance in both areas as compared to the control [82]. This suggests that musicians have a better recent memory which may be significantly attributed to their musical skills and training [82]. It may also suggest that musicians have an increased memory due to their use of multiple learning methods when practicing their respective instruments [82]. At the same time, individuals with dyslexia may have greater difficulty in utilizing recent memory because of their challenges with processing information [82]. Different sensory modalities can also influence recent memory and the way individuals can utilize it [82].

5.2. Pattern recognition

The use of TOMAL and other memory tests can provide trends for different groups with psychological impairments and provide better methods for teaching said groups [83]. This has been used for individuals with dyslexia as their impairment affects their performance on memory tests and pattern recognition [83]. In a significant study, various groups of dyslexic individuals were given a series of verbal and written tests to show their memory capabilities and were compared to non-dyslexic groups [83]. Although the dyslexic groups performed worse than non-dyslexic groups initially, a sharp increase was noticed if the dyslexic groups were provided strategies for solving the problems [83]. This indicates that people with dyslexia do not have an issue with memory but instead with strategies and pattern recognition, thus leading to dyslexic individuals requiring assistance in finding appropriate strategies for tests which may prevent many from being diagnosed with dementia or another memory impairment if they are given a memory test [83]. This further supports the idea that specific groups may not perform well on memory tests due to their inability to find the correct strategies, which greatly differ from that of memory impairment [83]. Another factor that feeds into the effects of long-term memory is the relative fitness of the individual, as it was discovered that both children and adults who engaged in aerobic exercise showed an increase in their ability to recall specific words [83]. This also showed that when the children in the study first exercised and then performed the memory tasks, they would out-perform those who did not exercise beforehand [83]. It was also found that in the control group, they improved as time progressed, improving their scores [84].

5.3. Pathophysiological states

The pathophysiological states of an individual change how some of the tests are conducted, as well as the ways in which the person can interact with the administrator of the said test [85, 86]. The first of several key conditions that can act as a confounder to these tests is the use of different intoxicating substances (i.e., Ethyl alcohol) that may be taken for various medical or physical conditions, impacting cognitive and/or visual abilities essential for test-taking [108, 109]. Secondly, delirium from various origins could potentially lead to an inability to perform well with the memory tests despite being considered otherwise normal [106, 107]. Thirdly, test-taking abilities for certain groups may be limited due to disorders such as ADHD, as was proven by a controlled study which gave two types of tests; verbal tests in which the adults with ADHD performed significantly lower than the control group, and the second being visual tests in which the adults with ADHD performed with no significant difference [85]. In another study, the TOMAL was able to determine the psychological state of ADHD individuals as they performed lower in the test’s verbal, visual memory, and pattern recognition areas [86]. This allowed for different learning strategies to then be made for children that scored low in specific areas, which were then shown in a secondary test [86].

5.4. Limitations of the tests

One of the main methods of short-term testing memory is by utilizing word lists, as it was found that by doing so, the participants who had learned to read were outperforming those who could not read [87]. However, it was found that this method was limited, and in other short-term memory tasks, the student who had not learned to read performed at the same level as the students who could read [87]. Additionally, this study found it challenging to obtain children for testing due to external factors [87].

6. LIMITATIONS OF THIS STUDY

Because of the nature of a scoping literature review, this paper is not all-inclusive of the total information that may interest a clinician or researcher [104]. Instead, it only looks to purview what is currently being utilized on a day-to-day basis in either the research setting or clinical environment. Secondarily, because of the nature of the exclusion of the articles from before the year 1980, other articles and seminal works may not have been included in this literature review. Finally, this study split the human population into only three groups of interest but neglected adolescents and the sub-divisions of adulthood (early, middle, and late); thus, specific tests designed to measure the overall memory of these individuals may not have been included in the searches because of the niche nature of these examinations. Therefore, further review and a deeper dive into the literature are the highest recommendations of the authorial team for further research studies.

7. CONCLUSION

The purpose of this scoping literature review was to determine what is known about both the method of testing memory for long-term and short-term memory and to determine which of these methods may be useful in testing the memory. The study accomplished this by following the established methods for a scoping literature review with the guidelines to identify available memory tests, their validity within the field, and the different limitations for each test within its respective age group. The combined search strategy yielded over 93,000 articles, of which 88 were included. The use of different memory tests in the major age demographics (pediatrics, adult, and geriatrics) was evaluated, and the findings from the different articles were summarized as well as included in a table. These 88 peer-reviewed sources were utilized in the development of this scoping literature review on the current standard assessment tools for measuring the psychometric properties of memory, recall, and learning. Further review and a deeper dive into the literature are the highest recommendations of the authorial team for further research studies.

REFERENCES

[1] Raba AAA, Ismail IA. Investigating Schools' Role in Enhancing Creative Thinking Skills in the English Curricula from Teachers' Perspectives. https://wwwhilarispublishercom/open-access/investigating-schools-role-in-enhancing-creative-thinking-skills-in-the-english-curricula-from-teachers-perspectivespdf. 2020;12(1). Available from: https://www.hilarispublisher.com/open-access/investigating-schools-role-in-enhancing-creative-thinking-skills-in-the-english-curricula-from-teachers-perspectives.pdf

[2] Overbaugh RC, Schultz L, Schultzrichard L, Overbaugh C. CET TL BloomsTaxonomy. 2011. Available from: http://www.fitnyc.edu/files/pdfs/CET_TL_BloomsTaxonomy.pdf

[3] Krathwohl DR. A Revision of Bloom's Taxonomy: An Overview. Theory Into Practice. 2002;41(4):212–8. DOI: 10.1207/s15430421tip4104_2

[4] Adams NE. Bloom's taxonomy of cognitive learning objectives. Journal of the Medical Library Association : JMLA. 2015;103(3):152–3. DOI: 10.3163/1536-5050.103.3.010

[5] Mehrens WA, Kaminski J. Methods for Improving Standardized Test Scores: Fruitful, Fruitless, or Fraudulent? Educational Measurement: Issues and Practice. 1989;8(1):14–22. DOI: 10.1111/j.1745-3992.1989.tb00304.x

[6] Haladyna T, Nolen S, Haas N. Raising standardized achievement test scores and the origins of test score pollution. Educational Researcher. 1991 [Accessed 2022 Apr 12];20(5). Available from: https://files.eric.ed.gov/fulltext/ED349826.pdf

[7] No Pain, High Gain Standardized Test Preparation. Instructor. 1997;107(3):89. Available from: https://soe.umich.edu/sites/default/files/2020-01/DukeCV10.29.19.pdf

[8] Volante L. Toward Appropriate Preparation for Standardized Achievement Testing. Journal of Educational Thought / Revue de la Pensée Educative. 2018;40(2):129–44. DOI: 10.11575/jet.v40i2.52568

[9] Atkinson R. Standardized Tests and Access to American Universities. 2001; DOI: https://escholarship.org/uc/item/6182126z

[10] Haladyna TM. Perils of Standardized Achievement Testing. Educational Horizons. 2006;85(1):30–43. Available from: https://eric.ed.gov/?id=EJ750641

[11] Varkey T. "Watch Your Language": A Literature Review on the Use of Dirty words in Improving Memory for Adult Learners. Proclins Psychiat. 2021;1(1). Available from: http://proclins.com/article/Psychiatry-1-1001.pdf

[12] Yang Y, Wang J-Z. From Structure to Behavior in Basolateral Amygdala-Hippocampus Circuits. Frontiers in Neural Circuits. 2017;11:86. DOI: 10.3389/fncir.2017.00086

[13] Richter-Levin G, Akirav I. Amygdala-Hippocampus Dynamic Interaction in Relation to Memory. Molecular Neurobiology. 2000;22(1-3):011–20. DOI: 10.1385/mn:22:1-3:011

[14] David B. Morris. The Neurobiology of the Obscene: Henry Miller and Tourette Syndrome. Literature and Medicine. 1993;12(2):194–214. DOI: 10.1353/lm.2011.0100

[15] Harris CL, Aycicegi A, Gleason JB. Taboo words and reprimands elicit greater autonomic reactivity in a first language than in a second language. Applied Psycholinguistics. 2003;24(4):561–79. DOI: 10.1017/s0142716403000286

[16] Isenberg N, Silbersweig D, Engelien A, Emmerich S, Malavade K, Beattie B, et al. Linguistic threat activates the human amygdala. Proceedings of the National Academy of Sciences. 1999;96(18):10456–9. DOI: 10.1073/pnas.96.18.10456

[17] Barry DN, Maguire EA. Remote Memory and the Hippocampus: A Constructive Critique. Trends in Cognitive Sciences. 2019;23(2):128–42. DOI: 10.1016/j.tics.2018.11.005

[18] Basu S, Alapin JM, Dines M, Lamprecht R. Long-term memory is maintained by continuous activity of Arp2/3 in lateral amygdala. Neurobiology of Learning and Memory. 2020 Jan;167:107115. DOI: 10.1016/j.nlm.2019.107115

[19] O'Reilly RC, Rudy JW. Computational principles of learning in the neocortex and hippocampus. Hippocampus. 2000;10(4):389–97. DOI: 10.1002/1098-1063(2000)10:4%3C389::AID-HIPO5%3E3.0.CO;2-P

[20] Pyc MA, Rawson KA. Testing the retrieval effort hypothesis: Does greater difficulty correctly recalling information lead to higher levels of memory? Journal of Memory and Language. 2009;60(4):437–47. DOI: 10.1016/j.jml.2009.01.004

[21] Benton AL. Neuropsychological Assessment. Annual Review of Psychology. 1994;45(1):1–23. DOI: 10.1146/annurev.ps.45.020194.000245

[22] Cipolotti L, Warrington EK. Neuropsychological assessment. Journal of Neurology, Neurosurgery & Psychiatry. 1995;58(6):655–64. DOI: 10.1136/jnnp.58.6.655

[23] Sullivan K. Neuropsychological Assessment of Mental Capacity. Neuropsychology Review. 2004;14(3):131–42. DOI: 10.1023/b:nerv.0000048180.86543.39

[24] Schaughency EA, Lahey BB, Hynd GW, Stone PA, Piacentini JC, Frick PJ. Neuropsychological test performance and the attention deficit disorders: Clinical utility of the Luria-Nebraska Neuropsychological Battery—Children's Revision. Journal of Consulting and Clinical Psychology. 1989;57(1):112–6. DOI: 10.1037/0022-006x.57.1.112

[25] Iverson G, Brooks B, White T, Stern R. Neuropsychological Assessment Battery: Introduction and advanced interpretation. 2008 [Accessed 2022 Apr 12]. Available from: https://psycnet.apa.org/record/2007-16755-010

[26] Temple RO, Zgaljardic DJ, Abreu BC, Seale GS, Ostir GV, Ottenbacher KJ. Ecological validity of the neuropsychological assessment battery screening module in post-acute brain injury rehabilitation. Brain Injury. 2009;23(1):45–50. DOI: 10.1080/02699050802590361

[27] Moms JC, Heyman A, Mohs RC, Hughes JP, van Belle G, Fillenbaum G, et al. The Consortium to Establish a Registry for Alzheimer's Disease (CERAD). Part I. Clinical and neuropsychological assesment of Alzheimer's disease. Neurology. 1989;39(9):1159–9. DOI: 10.1212/wnl.39.9.1159

[28] Board of Directors. American Academy of Clinical Neuropsychology (AACN) Practice Guidelines for Neuropsychological Assessment and Consultation. The Clinical Neuropsychologist. 2007;21(2):209–31. DOI: 10.1080/13825580601025932

[29] Elbulok-Charcape, Rabin M, Spadaccini L, Barr A, William B. Trends in the neuropsychological assessment of ethnic/racial minorities: A survey of clinical neuropsychologists in the United States and Canada. 2014 [Accessed 2022 Apr 12]. Available from: https://psycnet.apa.org/fulltext/2014-29268-005.html

[30] Cognitive Tests and Performance Validity Tests. www.ncbi.nlm.nih.gov. National Academies Press (US); 2015 [Accessed 2022 Apr 12]. Available from: https://www.ncbi.nlm.nih.gov/books/NBK305230

[31] Groth-Marnat G. Neuropsychological Assessment in Clinical Practice: A Guide to Test Interpretation and Integration | Wiley. 2000 [Accessed 2022 Apr 12]. Available from: https://www.wiley.com/en-us/Neuropsychological+Assessment+in+Clinical+Practice%3A+A+Guide+to+Test+Interpretation+and+Integration-p-9780471193258

[32] WHO. International Classification of Functioning, Disability and Health (ICF). 2001 [Accessed 2022 Apr 12]. Available from: https://www.who.int/standards/classifications/international-classification-of-functioning-disability-and-health

[33] Atkinson RC, Shiffrin RM. Human Memory: a Proposed System and Its Control Processes. Psychology of Learning and Motivation. 1968;2(1):89–195. DOI: 10.1016/s0079-7421(08)60422-3

[34] Tulving E. Multiple memory systems and consciousness. Human Neurobiology. 1987;6(2):67–80. Available from: https://pubmed.ncbi.nlm.nih.gov/3305441/

[35] Tulving E. MEMORY SYSTEMS AND THE BRAIN. Clinical Neuropharmacology. 1992;15(Part A):327A. Available from: https://journals.lww.com/clinicalneuropharm/Citation/1992/01001/MEMORY_SYSTEMS_AND_THE_BRAIN.169.aspx

[36] Stimmel M, Green D, Belfi B, Klaver J. Exploring the Accuracy and Utility of the Rey Fifteen Item Test (RMT) with Recognition Trial in a Forensic Psychiatric Population. International Journal of Forensic Mental Health. 2012;11(1):51–8. DOI: 10.1080/14999013.2012.676148

[37] Green P, Lees-Haley PR, Allen LM. The Word Memory Test and the Validity of Neuropsychological Test Scores. Journal of Forensic Neuropsychology. 2003;2(3-4):97–124. DOI: 10.1300/j151v02n03_05

[38] Rees LM, Tombaugh TN, Gansler DA, Moczynski NP. Five validation experiments of the Test of Memory Malingering (TOMM). Psychological Assessment. 1998;10(1):10–20. DOI: 10.1037/1040-3590.10.1.10

[39] Choi W, Jung JJ, Grantcharov T. Impact of Hawthorne effect on healthcare professionals: a systematic review. 2019 [Accessed 2022 Apr 12]; Available from: https://www.semanticscholar.org/paper/Impact-of-Hawthorne-effect-on-healthcare-a-review-Choi-Jung/a151788980bb64c00206b9762bd02a766db1fbf4

[40] Dumitrescu AL. The Hawthorne Effect. Understanding Periodontal Research. 2012;459–63. DOI: 10.1007/978-3-642-28923-1_15

[41] McCambridge J, Witton J, Elbourne DR. Systematic review of the Hawthorne effect: New concepts are needed to study research participation effects. Journal of Clinical Epidemiology. 2014;67(3):267–77. DOI: 10.1016/j.jclinepi.2013.08.015

[42] Fernald DH, Coombs L, DeAlleaume L, West D, Parnes B. An assessment of the Hawthorne Effect in practice-based research. Journal of the American Board of Family Medicine: JABFM. 2012;25(1):83–6. DOI: 10.3122/jabfm.2012.01.110019

[43] McCarney R, Warner J, Iliffe S, van Haselen R, Griffin M, Fisher P. The Hawthorne Effect: a randomised, controlled trial. BMC Medical Research Methodology. 2007;7(1). DOI: 10.1186/1471-2288-7-30

[44] Fuster JM. Frontal lobe and cognitive development. Journal of neurocytology. 2002;31(3-5):373–85. DOI: 10.1023/a:1024190429920

[45] Klingberg T, Vaidya CJ, Gabrieli JDE, Moseley ME, Hedehus M. Myelination and organization of the frontal white matter in children. NeuroReport. 1999;10(13):2817–21. DOI: 10.1097/00001756-199909090-00022

[46] Shute GE, Huertas V. Developmental variability in frontal lobe function. Developmental Neuropsychology. 1990;6(1):1–11. DOI: 10.1080/87565649009540445

[47] Lowe PA, Mayfield JW, Reynolds CR. Gender differences in memory test performance among children and adolescents. Archives of Clinical Neuropsychology. 2003;18(8):865–78. DOI: 10.1093/arclin/18.8.865

[48] Reynolds C. Factor structure, factor indexes, and other useful statistics for interpretation of the Test of Memory and Learning (TOMAL). Archives of Clinical Neuropsychology. 1996;11(1):29–43. DOI: 10.1016/0887-6177(95)00027-5

[49] Donders J. PERFORMANCE ON THE TEST OF MEMORY MALINGERING IN A MIXED PEDIATRIC SAMPLE. Child Neuropsychology. 2005;11(2):221–7. DOI: 10.1080/09297040490917298

[50] Kirk JW, Harris B, Hutaff-Lee CF, Koelemay SW, Dinkins JP, Kirkwood MW. Performance on the Test of Memory Malingering (TOMM) among a large clinic-referred pediatric sample. Child Neuropsychology. 2011;17(3):242–54. DOI: 10.1080/09297049.2010.533166

[51] Weber Ku E, Oliveira JS, Cook NE, McCurdy K, Kavanaugh B, Cancilliere MK, et al. Assessing performance validity with the TOMM and automatized sequences task in a pediatric psychiatric inpatient setting. Child Neuropsychology. 2020;26(6):801–16. DOI: 10.1080/09297049.2020.1712345

[52] Brooks BL, Sherman EMS, Krol AL. Utility of TOMM Trial 1 as an Indicator of Effort in Children and Adolescents. Archives of Clinical Neuropsychology. 2011;27(1):23–9. DOI: 10.1093/arclin/acr086

[53] Lah S, Epps A, Levick W, Parry L. Implicit and explicit memory outcome in children who have sustained severe traumatic brain injury: Impact of age at injury (preliminary findings). Brain Injury. 2010;25(1):44–52. DOI: 10.3109/02699052.2010.531693

[54] Gascoigne MB, Barton B, Webster R, Gill D, Antony J, Lah SS. Accelerated long-term forgetting in children with idiopathic generalized epilepsy. Epilepsia. 2012;53(12):2135–40. DOI: 10.1111/j.1528-1167.2012.03719.x

[55] Rhodes SM, Park J, Seth S, Coghill DR. A comprehensive investigation of memory impairment in attention deficit hyperactivity disorder and oppositional defiant disorder. Journal of Child Psychology and Psychiatry. 2011;53(2):128–37. DOI: 10.1111/j.1469-7610.2011.02436.x

[56] Gathercole SE, Woolgar F, Kievit RA, Astle D, Manly T, Holmes J. How Common are WM Deficits in Children with Difficulties in Reading and Mathematics? Journal of Applied Research in Memory and Cognition. 2016;5(4):384–94. DOI: 10.1016/j.jarmac.2016.07.013

[57] Law C, Juraskova I, Lah S. Systematic review of pediatric memory questionnaires. Child Neuropsychology. 2021;27(6):734–81. DOI: 10.1080/09297049.2021.1888908

[58] Alloway TP, Gathercole SE, Kirkwood H, Elliott J. The working memory rating scale: A classroom-based behavioral assessment of working memory. Learning and Individual Differences. 2009;19(2):242–5. DOI: 10.1016/j.lindif.2008.10.003

[59] Absatova K. Applying Automated Working Memory Assessment and Working Memory Rating Scale in Russian Population. The Russian Journal of Cognitive Science. 2016;3(1-2):21–33. Available from: http://www.cogjournal.ru/3/2/pdf/AbsatovaRJCS2016.pdf

[60] Guzman-Orth D, Grimm R, Gerber M, Orosco M, Swanson HL, Lussier C. Psychometric Properties of the Working Memory Rating Scale for Spanish-Speaking English Language Learners. Journal of Psychoeducational Assessment. 2014;33(6):555–67. DOI: 10.1177/0734282914558710

[61] Engel de Abreu PMJ, Nikaedo C, Abreu N, Tourinho CJ, Miranda MC, Bueno OFA, et al. Working Memory Screening, School Context, and Socioeconomic Status. Journal of Attention Disorders. 2013;18(4):346–56. DOI: 10.1177/1087054713476138

[62] Normand S, Tannock R. Screening for Working Memory Deficits in the Classroom. Journal of Attention Disorders. 2012;18(4):294–304. DOI: 10.1177/1087054712445062

[63] Wiguna T, WR NS, Kaligis F, Belfer ML. Learning Difficulties and Working Memory Deficits among Primary School Students in Jakarta, Indonesia. Clinical Psychopharmacology and Neuroscience. 2012;10(2):105–9. DOI: 10.9758/cpn.2012.10.2.105

[64] Politimou N, Masoura E, Kiosseoglou G. Working Memory Rating Scale's Utility to Identify Children's Memory Difficulties in Diverse Educational Environments: Can It Work in Every School? Applied Cognitive Psychology. 2015;29(2):291–8. DOI: 10.1002/acp.3107

[65] Cottingham ME, Hawkins KA. Verbal fluency deficits co-occur with memory deficits in geriatric patients at risk for dementia: Implications for the concept of mild cognitive impairment. Behavioural Neurology. 2010;22(3-4):73–9. DOI: 10.3233/ben-2009-0246

[66] Hering A, Kliegel M, Rendell PG, Craik FIM, Rose NS. Prospective Memory Is a Key Predictor of Functional Independence in Older Adults. Journal of the International Neuropsychological Society. 2018;24(6):640–5. DOI: 10.1017/s1355617718000152

[67] Optale G, Urgesi C, Busato V, Marin S, Piron L, Priftis K, et al. Controlling Memory Impairment in Elderly Adults Using Virtual Reality Memory Training: A Randomized Controlled Pilot Study. Neurorehabilitation and Neural Repair. 2009;24(4):348–57. DOI: 10.1177/1545968309353328

[68] Rhodes RE, Katz B. Working memory plasticity and aging. Psychology and Aging. 2017;32(1):51–9. DOI: 10.1037/pag0000135

[69] Adam KCS, Serences JT. Working Memory: Flexible but Finite. Neuron. 2019;103(2):184–5. DOI: 10.1016/j.neuron.2019.06.025

[70] B. Brent Simmons, Hartmann B, DeJoseph D. Evaluation of Suspected Dementia. American Family Physician. 2011;84(8):895–902. Available from: https://www.aafp.org/afp/2011/1015/p895.html

[71] Fuld PA, Masur DM, Blau AD, Crystal H, Aronson MK. Object-memory evaluation for prospective detection of dementia in normal functioning elderly: Predictive and normative data. Journal of Clinical and Experimental Neuropsychology. 1990;12(4):520–8. DOI: 10.1080/01688639008400998

[72] Wall JR, Deshpande SA, MacNei SE, Lichtenberg PA. The Fuld Object Memory Evaluation, a Useful Tool in the Assessment of Urban Geriatric Patients. Clinical Gerontologist. 1998;19(1). Available from: https://www.tandfonline.com/doi/abs/10.1300/J018v19n01_04?casa_token=UlBeObLIKqwAAAAA:hTdzn4oyeUrOx3BVF3irr7vbadkJCgJkIB8bdRcOBTbqiDOJHTKJa6uakX_r2Hhd1duPUI-LOJsH

[73] Summers JD, Lichtenberg PA, Vangel SJ. Fuld Object-Memory Evaluation in an Urban Geriatric Population. Clinical Gerontologist. 1995;15(4):21–34. DOI: 10.1300/j018v15n04_03

[74] Schwartz GE. Development and Validation of the Geriatric Evaluation by Relative's Rating Instrument (Gerri). Psychological Reports. 1983;53(2):479–88E. DOI: 10.2466/pr0.1983.53.2.479

[75] Moorhouse P, Gorman M, Rockwood K. Comparison of EXIT-25 and the Frontal Assessment Battery for Evaluation of Executive Dysfunction in Patients Attending a Memory Clinic. Dementia and Geriatric Cognitive Disorders. 2009;27(5):424–8. DOI: 10.1159/000212755

[76] Quinlan PT, Cohen DJ. Grouping and binding in visual short-term memory. Journal of Experimental Psychology: Learning, Memory, and Cognition. 2012;38(5):1432–8. DOI: 10.1037/a0027866

[77] John K. Selected short-term memory tests as predictors of reading readiness. Psychology in the Schools. 1998;35(2). Available from: https://onlinelibrary.wiley.com/doi/10.1002/(SICI)1520-6807(199804)35:2%3C137::AID-PITS5%3E3.0.CO;2-M

[78] Leyk D, Sievert A, Heiss A, Gorges W, Ridder D, Alexander T, et al. Validation of a short-term memory test for the recognition of people and faces. Ergonomics. 2008;51(8):1125–36. DOI: 10.1080/00140130802094371

[79] Gómez-Pérez E, Ostrosky-Solís F. Attention and Memory Evaluation Across the Life Span: Heterogeneous Effects of Age and Education. Journal of Clinical and Experimental Neuropsychology. 2006;28(4):477–94. DOI: 10.1080/13803390590949296

[80] Tatum PE, Shaida Talebreza, Ross JS. Geriatric Assessment: An Office-Based Approach. American Family Physician. 2018;97(12):776–84. Available from: https://www.aafp.org/afp/2018/0615/p776.html

[81] De Luca CR, Wood SJ, Anderson V, Buchanan J-A, Proffitt TM, Mahony K, et al. Normative Data From the Cantab. I: Development of Executive Function Over the Lifespan. Journal of Clinical and Experimental Neuropsychology. 2003;25(2):242–54. DOI: 10.1076/jcen.25.2.242.13639

[82] Kimel E, Weiss AH, Jakoby H, Daikhin L, Ahissar M. Short-term memory capacity and sensitivity to language statistics in dyslexia and among musicians. Neuropsychologia. 2020;149:107624. DOI: 10.1016/j.neuropsychologia.2020.107624

[83] Bacon AM, Parmentier FBR, Barr P. Visuospatial memory in dyslexia: Evidence for strategic deficits. Memory. 2013;21(2):189–209. DOI: 10.1080/09658211.2012.718789

[84] Etnier JL, Sprick PM, Labban JD, Shih C-H, Glass SM, Vance JC. Effects of an aerobic fitness test on short- and long-term memory in elementary-aged children. Journal of Sports Sciences. 2020;38(19):2264–72. DOI: 10.1080/02640414.2020.1778251

[85] Skodzik T, Holling H, Pedersen A. Long-Term Memory Performance in Adult ADHD. Journal of Attention Disorders. 2016;21(4):267–83. DOI: 10.1177/1087054713510561

[86] Thaler NS, Allen DN, McMurray JC, Mayfield J. Sensitivity of the Test of Memory and Learning to Attention and Memory Deficits in Children with ADHD. The Clinical Neuropsychologist. 2010;24(2):246–64. DOI: 10.1080/13854040903277305

[87] Roediger HL, Karpicke JD. Test-Enhanced Learning: Taking Memory Tests Improves Long-Term Retention. Psychological Science. 2006;17(3):249–55. DOI: 10.1111/j.1467-9280.2006.01693.x

[88] Ventura LM, DeDios-Stern S, Oh A, Soble JR. They're not just little adults: The utility of adult performance validity measures in a mixed clinical pediatric sample. Applied Neuropsychology: Child. 2019;10(4):297–307. DOI: 10.1080/21622965.2019.1685522

[89] Miller EK, Lundqvist M, Bastos AM. Working Memory 2.0. Neuron. 2018;100(2):463–75. DOI: 10.1016/j.neuron.2018.09.023

[90] Bray N. Persistence is key. Nature Reviews Neuroscience. 2017;18(7):385–5. DOI: 10.1038/nrn.2017.70

[91] Bratzke D, Ulrich R. Short-term memory of temporal information revisited. Psychological Research. 2020; DOI: 10.1007/s00426-020-01343-y

[92] Dubreuil AM. Short term memory properties of sensory neural architectures. Journal of Computational Neuroscience. 2019;46(3):321–32. DOI: 10.1007/s10827-019-00720-w

[93] Norris D. Short-term memory and long-term memory are still different. Psychological Bulletin. 2017;143(9):992–1009. DOI: 10.1037/bul0000108

[94] Artuso C, Palladino P. Long-term memory effects on working memory updating development. Arslan B, editor. PLOS ONE. 2019;14(5):e0217697. DOI: 10.1371/journal.pone.0217697

[95] Williams DL, Minshew NJ, Goldstein G, Mazefsky CA. Long-term memory in older children/adolescents and adults with autism spectrum disorder. Autism Research. 2017;10(9):1523–32. DOI: 10.1002/aur.1801

[96] Bruno D, Schurmann Vignaga S. Addenbrooke's cognitive examination III in the diagnosis of dementia: a critical review. Neuropsychiatric Disease and Treatment. 2019;Volume 15:441–7. DOI: 10.2147/ndt.s151253

[97] Noone P. Addenbrooke's Cognitive Examination-III. Occupational Medicine. 2015;65(5):418–20. DOI: 10.1093/occmed/kqv041

[98] Cormier DC, Kennedy KE, Aquilina AM. Test Review: Wechsler Intelligence Scale for Children, Fifth Edition: Canadian 322 (WISC-VCDN) by D. Wechsler. Canadian Journal of School Psychology. 2016;31(4):322–34. DOI: 10.1177/0829573516648941

[99] Beal A. Wechsler intelligence scale for children. Canadian Journal of School Psychology. 2004;19(1):221–34. Available from: http://lmunet.idm.oclc.org/login?url=https://www.proquest.com/scholarly-journals/wechsler-intelligence-scale-children/docview/224371618/se-2?accountid=12101

[100] Nicky D. List of Standardized Tests | Study.com. 2020 [Accessed 2022 Apr 12]. Available from: https://study.com/academy/popular/list-of-standardized-tests.html

[101] Medina N, Neill DM. Fallout from the Testing Explosion: How 100 Million Standardized Exams Undermine Equity and Excellence in America's Public Schools. Third Edition (Revised). 1990 [Accessed 2022 Apr 12]; Available from: https://eric.ed.gov/?id=ED318749

[102] Ulmer L "Kate. STANDARDIZED EXAMS AND THE FACULTY: AN UNEASY ALLIANCE. The Journal of General Education. 1991;40:224–38. Available from: https://www.jstor.org/stable/27797138?casa_token=5AczG0BYEWsAAAAA%3AVeB90z4VediZj57MQHhadtmj6d34lLu95YW6CfQLurGRan01QdPFtlZZMm4x01nH0EXahNc4a67HCcNpWDUADx8YhFd2eembtctv-76bzkdtAzWNsMA

[103] Buchmann C, Condron DJ, Roscigno VJ. Shadow Education, American Style: Test Preparation, the SAT and College Enrollment. Social Forces. 2010;89(2):435–61. DOI: 10.1353/sof.2010.0105

[104] Arksey H, O'Malley L. Scoping studies: towards a methodological framework. International Journal of Social Research Methodology. 2005;8(1):19–32. DOI: 10.1080/1364557032000119616

[105] Wilkes M, Bligh J. Evaluating educational interventions. BMJ. 1999;318(7193):1269–72. DOI: 10.1136/bmj.318.7193.1269

[106] Tieges Z, Evans JJ, Neufeld KJ, MacLullich AMJ. The neuropsychology of delirium: advancing the science of delirium assessment. International Journal of Geriatric Psychiatry. 2017;33(11):1501–11. DOI: 10.1002/gps.4711

[107] Hart RP, Best AM, Sessler CN, Levenson JL. Abbreviated cognitive test for delirium. Journal of Psychosomatic Research. 1997;43(4):417–23. DOI: 10.1016/s0022-3999(97)00140-2

[108] Lister RG, Eckardt MJ, Weingartner H. Ethanol intoxication and memory. Recent developments and new directions. Recent Developments in Alcoholism: An Official Publication of the American Medical Society on Alcoholism, the Research Society on Alcoholism, and the National Council on Alcoholism. 1987;5:111–26. Available from: https://pubmed.ncbi.nlm.nih.gov/3550908/

[109] Tamerin JS, Weiner S, Poppen R, Steinglass P, Mendelson JH. Alcohol and Memory: Amnesia and Short-Term Memory Function During Experimentally Induced Intoxication. American Journal of Psychiatry. 1971;127(12):1659–64. DOI: 10.1176/ajp.127.12.1659