

International Encyclopedia of Rehabilitation

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Memory in the Elderly

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The domain of memory can be a confusing one to understand as there are a number of different types of memory that operate in different ways using different neural networks and regions of the brain. Information about these has been gained from techniques of imaging the brain during memory tasks, as well as from examining brains and memory performance of those who have lost certain types of memory. Most of us think of short-term memory as the memory for recent events, and long term memory as memory for things that happened years ago in the past. However, in the neurocognitive field short and long term memory are described differently. Memory is processed in three phases, namely, encoding, storage and retrieval. Memories are stored in two stages: short-term storage and long-term storage. Not all memories are processed from short-term storage to long-term storage. Memories of events with context in time and place that are processed into long-term storage, whether recent or remote, are termed episodic memories.

How memories are formed

When memories are formed, any of the five senses may be involved in their formation and associations between the different sensations will combine to form the memory. For example, an event may occur where a person walks in a field, sees some sheep, hears birds singing and feels the cold air on their skin. Thus, the sensations of sight, hearing and touch are all recorded in the brain and combine to form a memory of the walk (event). On the following day, this person may recall the walk when cued, for instance, either by someone asking what they did the day before, or by seeing some more sheep. This cue will activate all the recorded sensations from the day before and the memory will be retrieved. Each time the memory is retrieved, the event is newly remembered in the mind by associations between the different sensations reforming. Thus the memory for an event can change slightly from one occasion to another. This explains why, if two people are recalling the same event, their versions of the event may differ to some extent.

The more associations one has for a particular event, the quicker and easier it should be to recall it. The neurons in the brain form networks, and these networks will 'search' the different parts of the brain for links until the whole memory suddenly emerges. This may explain why, for some people remembering people's names is easier than for others. A person with a logical approach to learning will 'file' information into compartments in their brain. When trying to recall a name, they will search these compartments and find the name quite easily. Another person who uses no particular method of storing information will send their neurons on a search for a name without any method. Thus, the neural networks will take a longer time to retrieve the name. In fact the person may have forgotten they were searching for the

name until it suddenly pops into their head much later on. So, although the retrieval process is slow, the information (or memory) is still accessible and can be found.

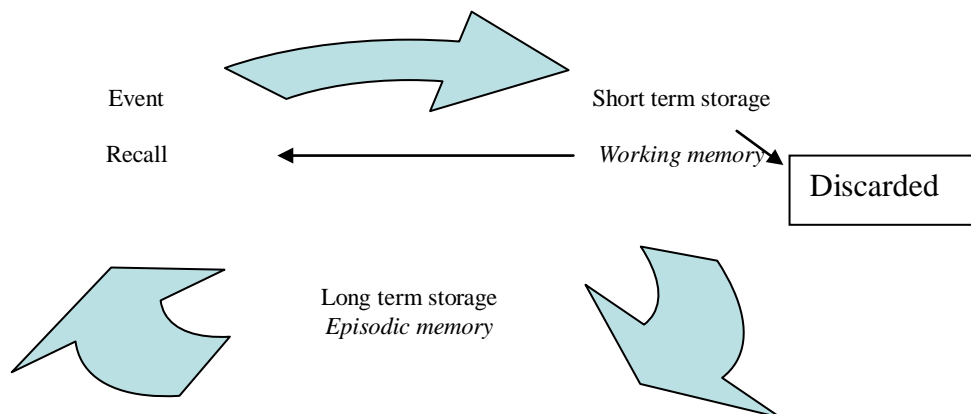


Fig.1 The process of encoding, storage and retrieval of memory

Memory Systems

Episodic Memory

This is the memory for events or episodes that happen in time and place. This is the type of memory that is important to distinguish from other types of memory when diagnosing Alzheimer's Disease, as episodic memory loss is usually the first symptom of the condition. There are many terms used by neuropsychologists to describe episodic memory in detail. Episodic memory can be either for **verbal** or **visual** information that is processed by the senses. Furthermore, it is processed in different stages, including **encoding or learning** (taking in and storing information), and **retrieval**, either by **recognition** (being able to select previously encoded information from an array of information presented) or **recall** (being able to remember information that is not represented, either with or without the help of cues). Memorising or storage of information can be either **implicit** (where information is absorbed without effort) or **explicit** (where effortful learning takes place). Implicit memory may be acquired by **priming** (with semantic or visual cues), conditioning or sensitisation. **Immediate** memory recall refers to recall of information that has just been encoded, while **delayed** recall refers to recall of information after a delay, suggesting that this information has been processed and stored in long-term storage in a retrievable form. Episodic memory is also referred to as **declarative** memory.

There are other ways of describing memory processes in this domain as well, including **anterograde** or **prospective** memory (remembering to do something in the future) and **retrograde memory** (remembering something that has already happened). **Recent** memory refers to episodic memory for recent events, while **remote** memory refers to memory for events and information from the distant past.

Procedural memory

This memory system refers to memory for the ability to perform procedures or retention of acquired skills, and includes well ingrained habits such as riding a bicycle, driving a car, brushing one's teeth, dressing etc. This memory system also allows for new learning such as how to use a new remote control for the television or to use a new household appliance. Procedural knowledge is not always available to

conscious awareness, so someone can suffer from amnesia, but still be able to carry out habitual activities. The procedural memory system may thus be suitable for specific types of rehabilitation interventions for memory impaired patients.

Three categories of procedural memory are recognised: **skill memory** including motor, cognitive and perceptual 'how to' learning, **priming** which refers to a form of cued recall in which, without the subjects' awareness or deliberate effort, prior exposure to visual or semantic cues facilitates the response, and **classical conditioning**.

Working Memory

This is the ability to remember information for a short period, from about 30 seconds up to one hour, while working with that information mentally. For example, remembering a telephone number after looking it up in a directory, until one has dialled it. Another example is the ability to do a mental calculation, for instance, in working out how much change to expect from a cash purchase in a store. This information is not needed once the immediate need has been met, and the information may be readily forgotten (or lost from short term storage), as it will not move into long-term storage regions in the brain. A model to describe these procedures is Baddeley's working memory model (Baddeley and Della Sala 1996) which includes a **phonological loop**, a finite store of words or word sounds, limited to a person's current span, and is responsible for inner speech and articulation, a **visuospatial scratch-pad**, responsible for setting up and manipulating mental images with an **episodic buffer** that integrates all the material in the working memory system, and the **central executive** which controls attention and coordinates these other aspects of the working memory model.

Semantic Memory

This is the memory for concrete or abstract information in the form of facts, concepts and names, whether for objects, people or places, but is not contextual. Semantic memory usually increases with age as a person accumulates knowledge. This knowledge can be expressed as language and may be learned by repetition and comprehension. Difficulties in this domain will often be reported by older people in terms of word and name finding difficulties, the 'tip-of-the-tongue' phenomenon and loss of fluency with speech, spelling and reading difficulties may be noticed.

What is the difference between age-associated memory loss and Alzheimer's disease?

Progressive episodic memory loss (for events with context in time and place) is usually the primary symptom of Alzheimer's disease (AD). However, because normal ageing is also associated with memory loss, it is necessary to distinguish between age-associated memory loss and memory loss that is due to AD pathology in the brain. Other mental or cognitive abilities may also be affected in the early stages of AD, but memory loss will be disproportionately greater than the loss in other domains. With normal ageing therefore, one would expect a more generalised decline in mental abilities that are not disproportionate to memory loss.

Normal ageing slows mental speed, and thus people take information in (encode) more slowly than before and they also retrieve stored information more slowly.

Slower encoding or learning of information may mean that less than the total amount of information presented is absorbed in the time available. This will result in less than the total amount of information being available for later retrieval. Secondly, what information is available for retrieval may take the brain cells longer to access and retrieve (remember).

However, if a person is losing neurons due to cell death or brain cells are becoming tangled or covered in plaque, memories will disappear or only be partially retained. Nerve cells will also have to bypass areas of damage to access memories and this can account for slower retrieval of information. Nerve cell activation or excitation may be lower as well, so that transmission of impulses from cell to cell is impaired. When information is taken in, the brain region where memories should be stored may no longer have sufficient neurons to store the information, thus new memories are not retained for very long, if at all.

Thus, to distinguish between normal ageing and AD, it is helpful to assess a person's ability to store new information and their ability to retrieve this information immediately and after a delay. This can be done with tests or tasks that should not be affected by a person's education level and their age. The test results can then be compared against norms tables that control for age and education. Norms are produced by averaging test scores of groups of mentally healthy people of particular ages and education levels. An individual person's performance can then be compared against the norms to determine whether they are doing as well as, better or worse than other people in their age group and with the same level of education. Norms tables are therefore a necessity for any published memory test.

Indicators of Memory Problems

- a) If you have a list of 10 words to remember, and give yourself three attempts to encode the list, you should be able to achieve this to a satisfactory level (e.g. 7 to 10/10 words for normal elderly over 60 years of age). If you can only learn 6 or less words, you could be performing at a lower level than expected. After a delay of 20 to 30 minutes, a normal retrieval score might be as good as your final trial 3 score or up to 2 points less (5/10). A person who can only recall on average, 4 or less words, would therefore be considered to be having retrieval problems. This may be an indication of memory impairment that is associated with the pathology of AD.
- b) To be certain of memory impairment, one should determine whether the person tested has always had a poor memory or whether their memory has deteriorated over time. This information can be obtained from the person tested or from someone who has known them well over a number of years. If a person has noted a decline in memory performance this is termed a Subjective Memory Complaint. Complaints will often be the reason people consult their GP or a memory clinic for an assessment. Standardised questionnaires may be used in clinical trials and in research studies to identify older people with memory complaints.
- c) Another important aspect of memory performance is how it affects one in one's daily life. Once a person or their relatives notice that memory loss is affecting a person's ability to safely look after themselves, to carry out

household tasks or work, to look after finances, to make sound judgements and solve problems or to be oriented with regards to time and place, it is more likely that a person has a problem that is not just due to normal ageing. At this stage it is important that the person gets a full neuropsychological assessment to rule out other causes of memory loss and to check whether the pattern of memory loss fits with that described for Alzheimer's disease or other form of dementia.

Cognitive Screening for Alzheimer's disease and other dementias

An initial screen for cognitive impairment may be done to determine whether someone needs a specialist assessment at a memory clinic. A number of screening tests and batteries have been developed since the mid-1900's when the Blessed Dementia Scale (Blessed et al. 1968) was produced by neuropsychologists in the UK to test memory, concentration, activities of daily living and personality change. In the USA, the Mini-Mental State Examination (MMSE) was published by Marshal Folstein (Folstein et al. 1975). This has become the most widely used dementia screening test in the world, and has been translated into many other languages. The MMSE only takes about 10 minutes to administer and can be used at the hospital bedside, in the GP's office or for research purposes and clinical drug trial monitoring. Although the MMSE is useful for detecting dementia, it is a simple test, so it can be used with people with low levels of education, but it is not very sensitive to cognitive impairment in highly educated people and in people with pre-symptomatic dementia or mild cognitive impairment. More comprehensive test batteries that take longer to administer would therefore be recommended in the clinical setting if a more accurate diagnosis is needed.

Cognitive screening tests or batteries of tests usually aim to examine a number of different cognitive domains that relate to functions of different parts of the brain or that involve a series of neural networks in the brain. The most commonly tested cognitive domains used include a comprehensive list, each of which will be described:

- Episodic memory (described above)
- Working memory (described above)
- Semantic Memory (described above)
- Language
- Attention
- Executive function
- Praxis
- Orientation
- Visuospatial skills
- Mental processing speed
- Motor speed
- Perception

Attention

This is a cognitive domain that can be described in a number of ways, namely sustained, selective and divided attention.

Sustained attention requires concentration on a simple task over time, while divided attention requires the ability to attend to more than one task at the same time, or being able to multi-task. Selective attention refers to the ability to selectively attend to a given task without being distracted by other information that is concurrently detected. Attention and other cognitive processes do overlap, as it is impossible to learn or memorise information without paying attention to it. Attentional processes can also be affected by deterioration of sensory faculties such as eyesight and hearing.

Executive function

This is a complex cognitive domain that involves higher order thinking and may be reflected in planning, judgement and decision making skills. It also involves attentional skills, mental flexibility and the ordering or categorising of information. This domain has been described in terms of controlling attention and working memory processes through a phonological loop and visual scratch pad (Baddeley 1998). Thus factual or memorised information may be brought to mind and used to design, plan, judge or decide on an activity or course of behaviour using a mental scratch pad (or the working memory). Decisions can be made almost instantaneously or may take time.

Praxis

This term refers to a person's ability to perform complex actions, either physical, verbal or other actions in response to a command or request, eg. to wave goodbye. It also demonstrates whether motor skills and coordination are intact. Difficulties in speech may be due to problems with articulation of sounds and words and may also result from difficulties with movements of face, larynx and other speech associated structures.

Orientation

Orientation is determined in relation to time, place and person. Orientation to time is assessed as the ability to keep track of the date, the time of day and the season, while orientation to place involves the ability to find one's way around new surroundings, familiar neighbourhoods and one's own home and recognising one's surroundings. Orientation impairments may affect a person's ability to remember their own age or birth date or to recognise familiar people.

Visuospatial skills

This term covers a range of skills involving visual and motor abilities such as copying of drawings of objects, matching objects and description of visually presented objects. It can include recognition by touch, face matching, description, identification and voice recognition; skill in assessing spatial relationships between objects, relative sizes or lengths of items and how things fit together. Skills such as parking a car or working out what furniture will fit into a room, are other examples of visuospatial skills.

Processing speed

Mental speed is not a cognitive domain, but refers to the time it takes to assimilate information and respond and can also be referred to as 'reaction time'. Information or stimuli accessed by any of the five sensory organs will activate neurons and send

messages along neural pathways in chemical form and initiate a response, whether it be verbal or physical. Processing speed is known to decline with age, including everyday tasks, for instance, detecting and responding to traffic light changes, selecting the correct switches on appliances, and so forth.

Perception

Perception refers to the ability to perceive or extract information from the environment or from one's own body and to absorb and respond to it in a meaningful way. Visual, tactile and auditory senses as well as taste and smell may be involved. Loss of attentional processes in the brain or disturbances in the sensory organ receptors or in information processing may produce distorted images or misperceptions of external stimuli. Visual hallucinations may occur in some dementia conditions as well and may be visual, tactile, olfactory or auditory.

Neuropsychological testing

In essence, neuropsychology is the study of behaviour as it relates to brain function, whether healthy or impaired. The field of neuropsychology bridges the neurosciences and the behavioural sciences.

In the neurological domain behaviour is attributed to an underlying cause, such as a degenerative Alzheimer's pathology in the brain. But in the psychological domain, the neuropsychologist's diagnostic expertise is applied to describing the effects of the underlying cause on the client's behaviour.

Cognitive Testing

In the memory clinic or in a research setting when assessment is done to determine whether cognitive impairment is due to Alzheimer's Disease or other type of dementia, a relatively brief battery of tests that covers all the major cognitive domains needs to be used, or compiled from an appropriate selection of sensitive tests.

Two well-known test batteries in common use are the ADAS-Cog (Alzheimer's Disease Assessment Scale-Cognitive) (Chu et al. 2000) and the CAMCOG (Cambridge Cognitive Examination) which is part of the Cambridge Examination for Disorders of the Elderly (CAMDEX) (Roth et al. 1986). The Telephone Interview for Cognitive Status-modified (TICS-m) (de Jager et al. 2003), Montreal Cognitive Assessment (MOCA) (Roth et al. 1986) and the 7-minute Screen (7MS) (Solomon and Pendlebury 1998) are all brief screening tests for assessment of early cognitive impairment or AD (7MS) while the Mini Mental State Examination (MMSE) and the Severe Impairment Battery (SIB dementia) (Panisset et al. 1994) are used to screen for dementia. All of these scales contain tests that assess a range of cognitive domains, so that a global picture or profile of cognitive performance is obtained. Two of these scales, the MMSE and the ADAS-Cog have become standard, approved tests for use in many drug trials. However, they both have some shortcomings and as new and better tests and test batteries are developed, research centres, memory clinics and pharmaceutical companies involved in drug trials for intervention in Alzheimer's disease are trying out new and hopefully more sensitive measures of cognitive performance in domains affected by the disease at progressive stages.

There are certainly many variations on verbal memory tests, with word lists with different features that aim to measure both encoding with free recall (immediate) and retrieval (recognition and delayed recall). The most recent thinking is that memory tests should be based on associative learning and provide selective or cued reminding during the learning to aid recall. This means that a verbal test may have words that are linked in a certain way eg. Pairs of words such as 'baby' and 'cot', or categories of words, such as animals or food items. During retrieval, the first word of the pair 'baby' will act as the cue for remembering the other word 'cot', or knowing that the category of animals was part of the test may help one to remember the specific animals that were in the test. A similar construct is used in visual memory tests, where pictures of items (e.g. a table) belonging to various categories (e.g. furniture) can be presented during encoding, while during retrieval a question is asked naming the category (furniture) to the subject who responds with the specific item (table) that was in the picture. Initial work in tests of this type was done by Elizabeth Warrington at Queens Square in London and Grober and Buschke in the US (Grober et al. 1997).

All of these memory test designs take into account that for older people task difficulty will increase with increasing age. Thus, to remove the confounding effects of age on test performance, the task difficulty is reduced with cues to aid retrieval. These tests will help to distinguish between slow retrieval processes of older age and memory loss due to AD.

* The TICS-m is not currently available in Spanish, but is based on the MMSE, but includes a 10-wordlist for registration and delayed recall.

Activities of Daily Living Scales

Cognitive tests provide only one side of the picture, the laboratory type of performance captured at one time point in a memory clinic or other office environment with a neuropsychologist or other health professional. To balance this against a person's performance at home or during usual common activities, scales have been developed to provide simple, structured and quantifiable assessments of activities of daily living (ADL) that mimic a doctor's interview with a patient for dementia assessment. These scales cover items such as grooming, dressing, eating, bladder control and continence for assessment of moderate to severely demented patients, while items such as taking telephone messages, remembering news and stories read or watched on television, cooking ability, ability to perform hobbies, take part in social activities, find one's way around and make decisions, solve problems and handle finances will be included in scales for assessment of mild cognitive impairment or early Alzheimer's disease. Some scales assess more functional activities, while others are more geared towards memory items.

Well known ADL scales include the Blessed Dementia Scale (Blessed et al. 1968) H, Functional Assessment Scale (FAST) (Reisberg 1988), Barthel Index (Mahoney and Barthel 1965), the Global Deterioration Scale (GDS) (Reisberg et al. 1982), Bristol Activities of Living Scale (BADLS)* (Bucks et al. 1996), Disorders of Dementia (DAD)* (Gelinas et al. 1999) scale, the ADCS-ADL (Galasko et al. 1997), and the Instrumental Activities of Daily Living scale (IADL) (Lawton and Brody 1969). These questionnaires will usually be completed by a carer or someone who knows the patient well. The CAMDEX also has sections covering activities of daily living. The Clinical Dementia Rating (CDR) scale (Hughes et al. 1982), (Morris 1993) covers

both an informant interview as well as a patient-based assessment of five domains of function including orientation, memory, judgement and problem solving, hobbies and social activities and self-care.

A number of memory questionnaires have been developed for healthy persons and those with memory complaints in order to gather subjective indices of memory performance. It is thought that the first person to notice a decline in memory performance is the subject himself, more especially the well educated or highly intelligent. These people may do well on formal cognitive assessment, where scales are designed to capture performance in the normal range. People at the top end of the range may show a ceiling effect on cognitive tests. In other words, they score full marks as the test does not extend them to the full extent of their abilities. Only when such a person has more severe cognitive losses will tests be sensitive enough to detect it. Subjective memory scales include the Metamemory questionnaire* (Dixon et al. 1988), the Everyday Memory Questionnaire* (Cornish 2000), the Subjective Memory Questionnaire* (Hanninen et al. 1994).

* not available in Spanish

Mood, anxiety, depression

Cognitive performance can also be affected by mood or affective state, and AD and other dementias can cause changes in personality and behaviour. People who become aware of their memory problems may become depressed or overanxious about their performance. They may become aggressive, angry or apathetic, withdrawn and unmotivated, or disinhibited and display socially embarrassing or inappropriate behaviour as a result of neuropathological processes that manifest as dysfunctional behaviour. In order to complete the neuropsychological assessment, questionnaires may be used to assess mood or personality changes that may be associated with cognitive performance and ADL ratings. There are a wide range of scales to assess depression in older people including the Geriatric Depression Scale (GDS) (Yesavage 1988), the Hamilton Depression Scale (HDS) (Schwab et al. 1967). The Neuropsychiatric Inventory (NPI) is a comprehensive questionnaire covering a broad range of mood and behaviour states including apathy, anxiety, aggression etc.

Brief description of a neuropsychological assessment for detecting cognitive impairment and dementia

At OPTIMA, (<http://www.medsci.ox.ac.uk/optima>) as with other memory research centres and memory clinics in the UK and worldwide, validated tests that have high sensitivity and specificity for Mild Cognitive Impairment and Alzheimer's disease are used.

The assessment may start with the MMSE to determine whether the participant or patient scores above or below the dementia cut-off score or to determine whether they shows any decline from previous performance.

Following this initial stage, the participant would be asked a few questions about their subjective impression of their memory performance or they may be asked to fill in a brief Activities of Daily Living Questionnaire and a questionnaire assessing depression (GDS). Typically for patients with dementia, their carer may be asked to

complete some of the questionnaires on activities of daily living (BADLS-plus) and affective state giving their impression of the patient's behaviour (NPI). This may also take place as an informant interview by telephone using the CAMDEX questionnaire.

Next would follow the neuropsychological assessment of the participant with a neuropsychologist or a research nurse using a test battery that is used repeatedly at annual or other intervals with participants to obtain a longitudinal profile of their cognitive performance.

Diagnostic procedure

Further to the cognitive assessment, a clinical picture will be built up based on a person's medical and family history, blood tests and brain imaging scans, looking for factors that might contribute to accelerated decline of mental function. With all this information put together, the clinical team involved in an assessment would make a provisional diagnosis, and invite the patient and their family for a review of the assessment.

When testing for cognitive performance in older people with memory complaints, the following factors need to be taken into consideration: firstly, memory performance can be poor due to factors other than AD pathology. These include medical factors such as depression, vascular disease or stroke, transient ischaemic attacks, epilepsy, diabetes, hypothyroidism, Parkinson's Disease, Huntington's Disease, delirium or amnesia (that may be the result of recent head injury or concussion), drugs, certain medications and nutritional deficiencies.

Confounding factors on test results

Information on demographic factors is always collected when conducting either research or clinical trials as these factors are known to influence test performance, and may also be risk factors for memory loss and dementia. The most common factors included in statistical analysis of data on cognitive performance include:

- a) **Age** – older age (over 60 years) is associated with poorer memory and worse cognitive test performance. It is also a risk factor for AD with an approximate doubling of the incidence of Alzheimer's Disease with every 10-year increment in age.
- b) **Gender** – women are generally better at performance on verbal tasks than men, while men are better at spatial tasks. Women have been shown to be at higher risk of AD, but this may be confounded by the proportion of women living to greater age being higher than that of men. However, men with certain medical conditions, such as diabetes, may be at higher risk than women with the same medical condition.
- c) **Education** – increased years of education appears to be a protective factor against AD. This may reflect increased cognitive reserve due to stronger neural networks built up through greater mental stimulation or to healthy lifestyle choices made by those who are better informed.
- d) **IQ** – basic intelligence which is a fairly stable factor in adult life appears to be protective against AD. Conditions associated with mental retardation such as Down's syndrome have been associated with greater risk of AD.

- e) **Depression** - depression can affect concentration and dampen memory processes, but memory problems may induce depression as well. In both cases test performance will be negatively affected.
- f) **Race** – ethnic background, opportunities, socio-economic level and racial genetic differences may influence cognitive performance. It is important to use culture-fair tests whenever possible to obtain accurate measures of mental abilities and eliminate the possibility that differences in performance between different racial groups is due to poor comprehension of unfamiliar test materials.
- g) **Genetic risk factors** – although AD is not genetically inherited in the way that Down's syndrome is, it may be familial, or passed down in a family, so that a small percentage of cases (about 5%) are due to genetic and familial environmental factors. However, there are a number of genes that have been associated with increased risk of AD.
- h) **Illness** (eg. cardiovascular disease, diabetes) and medication. Stroke, heart disease, high blood pressure, hypothyroidism and diabetes may increase the risk of AD or other type of dementia. Certain drugs or medicines have been associated with poorer cognitive performance (e.g. anti-epileptics) while other drugs (such as NSAIDs and statins) have been shown in some studies to be associated with improved cognitive performance.
- i) **Lifestyle factors** – diet, coffee, tea, caffeine, vitamin supplements, smoking and alcohol intake may all affect cognitive performance, as may activity levels, stress levels and disrupted sleep.

How to determine whether you or someone close to you needs neuropsychological testing for memory loss related to Alzheimer's disease.

A list of common problems that people face with older age is listed below:

1	Forgetting why they went upstairs.	Occasionally, Once or twice a fortnight, every day
2	Forgetting names of relatives or friends.	Occasionally, Once or twice a fortnight, every day
3	Cannot think of a word when talking or doing a crossword.	Occasionally, Once or twice a fortnight, every day
4	Forgetting what someone just told them.	Never, Once or twice a fortnight, every day
5	Asking the same question over again.	Never, Once or twice a week, every day
6	Forgetting they have told a story and repeat it to a person.	Never, Once or twice a fortnight, every day
7	Forgetting what they did the day before.	Never, Once or twice a week, often
8	Unsure of the date (day/month/week).	Occasionally, Once or twice a week, often
9	Forgetting what they did the week before.	Never, sometimes, often
10	Forgetting what they did a month before.	Never, sometimes, often
11	Forgetting appointments.	Never, Once or twice a month, often
12	Forgetting to do something they were meant to do.	Occasionally, Once or twice a fortnight, often
13	Getting lost going out or coming home.	Never, Once or twice a fortnight, often
14	Forgetting their whereabouts.	Never, Once or twice a fortnight, often
15	Forgetting where they have put things.	Occasionally, Once or twice a fortnight, often
16	Memory is worse than it was a year ago.	No, maybe, yes
17	Memory has worsened more than ability to do other activities that require thinking eg. mental calculations, planning outings, cooking.	No, maybe, yes
18	Difficulty looking after finances as well as before.	No, maybe, yes
19	Difficulty coping with household chores as well as before.*	No, sometimes, yes
20	Slowed down mentally e.g. in learning how to use a new appliance, doing mental arithmetic, working out a problem.	No, maybe, yes
21	Difficulty coping with hobbies and interests as well as before*	No, sometimes, yes
22	Easily distracted, or losing concentration easily.	No, sometimes, yes
23	Losing track of a conversation, story or TV programme easily.*	No, sometimes, yes
24	Forgetting information if distracted while absorbing it.	No, sometimes, yes
25	Forgetting information even if not distracted when absorbing it.	No, sometimes, yes
26	Forget things if feeling low or a bit depressed.	No, sometimes, yes
27	Forget things even if in a good mood.	No, sometimes, yes

* Don't base judgement on physical limitations or poor hearing. The more of these symptoms one has and the more often they occur in relation to a person's usual previous performance the more likely the need for a memory clinic assessment. *Note.* This is not a validated scale.

Suggestions for maintaining mental stimulation and a healthy brain

A healthy lifestyle has been shown to be protective against AD. What you put into your body diet-wise affects your brain as much as it affects your physical health.

Certain fruits and vegetables rich in vitamins, anti-oxidants and minerals, as well as protein-rich foods containing B vitamins and omega-3 fatty acids, have been associated with better cognitive performance. Aerobic exercise, low stress levels and mental stimulation, through activities that involve complex thinking, and a regular level of social interaction have all been shown to be beneficial to brain health.

Mental stimulation refers to activities that engage the mind in active thinking and learning. Learning and cognitive stimulation are thought to increase the number of connections within the brain and also to enhance the strength of these connections. For example, a study of London taxi drivers who have to learn to navigate between numerous locations within the city (which can take up to two years to master) showed significant increases in the size of the memory centres in the brain (hippocampi) compared with controls (Maguire et al. 2000). Furthermore, the size of this region was found to increase with years spent as a taxi driver. Thus, our experiences have a direct impact on the structure of our brains. High levels of cognitive stimulation are thought to build up cognitive reserve which provides a greater ability to cope with pathological changes that occur in the brains of those with AD.

(Verghese et al. 2003) found that participating in one cognitive activity a week was associated with a 7% reduction in the risk of developing dementia. However they found no such association with physical activity in reducing the risk of dementia.

Mentally stimulating activities rated included: 1) Viewing television, 2) Listening to radio or to music, 3) Reading newspapers, 4) Reading magazines, 5) Reading books, 6) Playing cards/checkers/draughts/doing crosswords/other puzzles/quiz games, 7) Going to museums/botanical gardens/art galleries.

Other studies have reported on the benefits of activities such as playing musical instruments, bingo, bridge and dancing in reducing the risk of memory loss and dementia. Taking part in these kinds of activities about 4 times a week was shown to reduce the risk of AD by 66% (Verghese et al. 2003). A similar study found that increased mental activity was associated with reduced decline in overall cognitive performance by 47%, while episodic memory decline was reduced by 60% and perceptual speed by 30% (Wilson et al. 2002).

A Japanese study of AD patients in a care home showed that those who took part regularly in a programme of arithmetic and reading exercises during an appointment with a mental health professional showed improved performance in abstract thinking and were more mentally alert after 3 months than those patients who did not take part. It was not clear though how much benefit was derived simply from the increased amount of social interaction and attention received during the study.

Studies have also shown that improvement is more likely to take place in the cognitive domain that is used in the activity than in all cognitive domains. So, doing plenty of crossword puzzles may help to stimulate the areas of the brain involved in word finding, but may not help to improve episodic memory for events. However, episodic memory test performance does not correlate with functional activities of daily living as well as semantic memory and visuospatial skills do according to a study by (Garrard et al. 1997). So don't give up the crosswords and brain-teasers.

Currently, sudoku and computerised brain-teasers and exercises are being promoted in the media for maintaining mental health. Cognitive intervention trials may start to compete with drug trials for memory enhancement in those with early cognitive decline. Not everybody enjoys crosswords, sudoku or playing card games. The important thing to do is to choose mentally stimulating activities that one does enjoy, whether they be sedentary activities such as listening to music, reading or taking part in quizzes or games, or activities that include exercise such as dancing, tennis or golf. And to take part in these type of activities often and regularly to keep mentally alert and hopefully build up strong neural networks. Try to ensure that the activity is stimulating and mentally engaging, as mindless jogging, walking, television viewing, or browsing through magazines will be unlikely to be of benefit to cognitive performance.

To improve memory performance, try the following exercises

- a) Write a grocery list, rehearse it before shopping, but don't consult it while shopping until you think you have all the items on it, then check and see if you have missed anything.
- b) Try to remember names of people you meet. The trick with remembering new names is once you have been introduced to someone, use their name a few times straight away. Test yourself later on to see if you can remember the name/s. Another recommended technique is to look for something characteristic about the person you are introduced to, e.g. George with the grey moustache, and to form an association between 'Grey moustache' and 'George'.
- c) Commit a few new telephone numbers to memory, learn a new language (or at least a few new phrases), new dance routines or steps. Practice what you have learned until it becomes easy to recall.
- d) Listen to the news on the radio and then jot down all the facts you can remember. Check your facts later if the news is repeated.
- e) Be more organised: keep items like front door keys or car keys in a regular place, keep a diary for appointments, important dates or for recording events. The more often you consult your diaries and rehearse the items recorded, the better you should remember them.
- f) If you or someone you know is showing definite signs of poorer memory, put together a photograph album of important people in your/their life with captions to help you/them remember how they fit into your/their life. Keep albums of holiday photos to remind yourself of pleasurable times and places.

Mind Mapping

Tony Buzan's (Buzan 1991) techniques can also be used to organise information in your mind during study periods. We automatically categorise things mentally, for example, we may categorise animals into those that live and move around on land, in water or in the air or according to the species they belong to. In the same way, one

could organise information mentally into geographical or historical, mathematical or psychological zones.

Visual Imagery

Using visual imagery to aid memory is another recommended technique. For instance, if learning a list of words, picture each item as you read or hear it, and when recalling the words, remind yourself of the images you formed. Buzan recommends using four links for remembering: imagination, exaggeration, absurdity and colour. So if you have a list of groceries to buy, including eggs, bananas, milk and chicken, you should make up a short story involving all the items with vivid and colourful imagery. For example, you visualise walking out the door, slipping on a bright yellow BANANA skin, dropping all the blue EGGS you are carrying, and as they crack open on the pavement, you realise none will hatch and grow into CHICKENS, but with a bit of MILK you could make scrambled EGGS. When you arrive at the grocery store, you replay the story in your mind and remember all the items on your list.

Associations

Essentially, the more links you can make between items of information that you want to remember, the easier it should be to recall them, as one item will act as a cue for the other if you have previously formed a mental link between them.

Hobbies

Try to maintain your interests and hobbies as you age, within your physical limitations, but don't overload yourself with commitments.

De-stress

Too many commitments may cause you stress and confusion, especially if you find you are slowing down and can't keep track of all your activities as easily as before. Stress will not be beneficial, as it releases hormones in the brain that dampen the memory processes, and prolonged stress is thought to have long-term damaging effects on memory cells.

Social activity

Interact with all age groups if possible, including young children. Maintain a feeling of worth and usefulness in your community. Find avenues to pass on your knowledge and wisdom to others.

Diet

Eat as well balanced a diet as you can, with plenty of vegetables and fruit, as well as enough protein from fish, meat, eggs, milk or yoghurt to keep your B vitamin levels balanced. If it is difficult cooking for yourself, try meals-on-wheels or other pre-prepared supermarket meals that include vegetables and fish, chicken or red meat. Try to maintain some form of daily exercise, even if it's indoors, to keep your body toned and increase the amount of oxygen reaching the brain.

Orientation

If you have moved home, give yourself time to re-orient and familiarise yourself with your new neighbourhood, new neighbours and the layout of your new home and

possibly new daily routines. You will have a large amount of new learning to do in a short space of time, and this will be more difficult as you age. For someone with memory problems a move can take a lot of adjustment and reorientation, therefore the benefits should outweigh the negatives.

Don't worry

Most importantly, don't worry unduly about your memory. Worry may make things worse. Everybody slips up, makes mistakes, forgets the odd appointment or where they put their keys now and again.

Concentrate on the things you can do well and enjoy, keep mentally stimulated and maintain your independence for as long as you possibly can.

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