

Memory Disorders & Assessment : A mini-review

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ABSTRACT

Memory disorders and disturbances are frequently encountered in the clinical practice and are a feature of the majority of psychiatric and neurological conditions causing significant disability. With the rapidly evolving understanding of the nature, different forms and assessments of memory disorders, it becomes crucially important to periodically take stock of the nature of research that falls within its purview. Assessment of the nature of the memory disorder and the functional consequences for the individual should precede remediation and intervention planning. The present mini-review is one such attempt to provide a scan of the emerging empirical literature that has attempted to understand, assess and enhance memory disturbances in the clinical setting.

Keywords : Memory, Amnesic syndromes, Assessment

INTRODUCTION

The ability to store and recall the stored information is one of the most amazing capacities of higher organisms. Memory is the glue that holds our mental life together. If there is no memory, our experiences will be series of events without any meaningful connection. We remember events that happened in our childhood. We can recall skills learned earlier in the past. We can even be influenced by memories that we cannot explicitly remember. Whether we remember accurately or inaccurately, in detail or in abstract, are questions that researchers have investigating for many years.

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CLASSIFICATION OF MEMORY

There are various ways in which memory can be classified. One of the useful methods is based on duration as :

- Short Term Memory (Sensory Memory)
- Long Term Memory
- Working Memory

SENSORY MEMORY

Sensory memory is the ability to retain impressions of sensory information after the original stimulus has ceased. In one's daily routine activities, an individual is bombarded with numerous incoming stimuli or perceptions and through selective attention one focus upon a selective stimuli and discard the rest of them. One copy of these selected stimuli is initially registered for a few seconds in what is called as Sensory memory. Sensory memory corresponds approximately to the initial 200–500 milliseconds after an item is perceived.

SHORT TERM MEMORY

Short-term memory (or "primary" or "active memory") is the capacity for holding a small amount of information in mind in an active, readily available state for a short period of time. Short term memory is memory that can withhold information received from sensory register up to about 30 seconds. which is longer than the duration available to sensory memory and aids in constant updating of ones surrounding.^[1]

WORKING MEMORY

The concept of working memory (WM) was initially proposed by Baddeley and Hitch (1974) defining working memory as "A system for the temporary holding and manipulation of information during the performance of cognitive task such as comprehension, learning and reasoning."^[2] It is characterized by the assumption that short-term storage of information must be considered as part of a more complex system involved in the execution of a specific task. It is known as the workbench of consciousness, which it means is the place where the information we use right now is held and processed. As a storage system, working memory can hold only about seven plus or minus 2 discrete items.

LONG TERM MEMORY

Long Term Memory (LTM), provides lasting retention of information and skills from minutes to a lifetime and has a limitless capacity. The storage of material in long-term memory allows for recall of events from the past and for the utilization of information learned throughout life.

It is divided in to declarative and non-declarative memory.

Declarative memory also termed as explicit memory, encompasses all the information that we can consciously describe or report. It has been further subcategorized into :

- (a) Semantic memory which concerns memory for meaning, the storage of abstracts and general facts. Semantic memory is immensely important because it constitutes the knowledge base that allows us to communicate, use objects, recognize foods, react to environmental stimuli and function appropriately in the world.
- (b) Episodic memory or autobiographical memory is memories based upon a personal experience relating to self and is linked to a particular time and place in life. i.e memory based upon a personal experience relating to self for example ones wedding day and is thus linked to a particular time and place in our lives.

Non Declarative Memory refers to skills, habits or other manifestation of learning that can be expressed without an awareness of what has been learned. It is heterogeneous collection of unconscious or implicit memory abilities.

Subtypes –

1. **Procedural**
2. **Simple classical Conditioning**
3. **Priming**

Procedural memory, also known as implicit memory, is memory system that retains information we cannot readily express verbally- for example, information necessary to perform skilled motor activities like riding a bicycle.^[3]

Procedural memory is for knowing how to do things such as talk, walk, juggle etc. Procedural memory is rarely susceptible to forgetting and is also resistant to brain damage that erases other forms of memory like seen in anterograde amnesic patients who forget simple events or verbal instructions after a few moments.

Simple Classical Conditioning is another type of non-declarative memory that generally occurs in the presence of conscious awareness of conditioned stimulus (CS) and unconditioned stimulus (UCS) but can occur without awareness also.^[4]

Priming : When an object has just been perceived or processed, there is a tendency for that object to be perceived more easily the next time. Such priming operates across a wide range of sensory and motor systems, occurring at a range of different processing levels.[3] Priming is an implicit memory system. Priming often is divided into perceptual priming, which is modality specific (e.g. auditory, visual) and not dependent upon the depth of encoding at study, and conceptual priming, which is not modality specific and does benefit from elaborate encoding.

AMNESIC SYNDROMES

Korsakoff's Syndrome

Korsakoff's syndrome is mostly an irreversible residual syndrome, caused by severe thiamine deficiency and occurring after incomplete recovery from a Wernicke encephalopathy, predominantly in the context of alcohol abuse and malnutrition. It is characterized by an abnormal mental state in which episodic memory is affected compared to other cognitive functions in an otherwise alert and responsive patient. The individual may also be distinguished by executive dysfunction, flattened affect, apathy, lack of illness insight, and possibly by fantastic confabulations in the early stage.^[5] The severe memory impairment as a core characteristic for Korsakoff syndrome primarily relates to declarative memory.^[6] Within this declarative memory domain, both episodic memory, related to explicitly remembered personally experienced events specific to time and place, and semantic memory, related to facts, are affected. In each of these sub-domains, the anterograde memory processes are more severely affected than retrograde processes which is primarily due to a deficit in the contextual memory.

Transient Global Amnesia

Transient global amnesia (TGA) is a clinical syndrome which is characterized by sudden onset of significant reduction of anterograde and lesser reduction of retrograde episodic long-term memory. It is also

seen that the executive functions are described as diminished. Although it is suggested that various factors, such as migraine, focal ischemia, venous flow abnormalities, and epileptic phenomena, are involved in the pathophysiology and differential diagnosis of transient global amnesia, the factors triggering the emergence of these lesions are still not known. Recent studies have suggested that metabolic stress plays an important part leading to an impairment of hippocampal function during transient global amnesia.^[7]

Psychogenic amnesia

Psychogenic or dissociative amnesia is defined as "a disorder characterized by a retrospective gap in memory of important personal information, usually of a traumatic or stressful nature; the memory loss far exceeds ordinary forgetfulness and is not the result of substance use or the consequence of a medical condition". Amnesia is experienced as an essential feature of dissociative amnesia; which is commonly localized or selective amnesia, and rarely generalized amnesia. It is seen that patients with psychogenic amnesia are able to acquire and store new long-term memories. However, there is an impairment (or block) of episodic autobiographical memory which may arise after traumatic or stressful experiences.

Mild Cognitive Impairment

Mild cognitive impairment is a syndrome that is defined by a cognitive decline greater than that expected for an individual's age and education level but that does not interfere notably with activities of daily life as seen in dementia. Mild cognitive impairment with memory complaints and deficits (amnestic mild cognitive impairment) is consistently shown to have a high risk of progression to dementia, particularly of the Alzheimer type.^[8] The amnestic subtype of mild cognitive impairment is characterised by memory complaints, usually corroborated by an informant, memory impairment relative to age-matched and education-matched

healthy people, typical general cognitive function, largely intact activities of daily living and the individuals being not clinically demented.

Confabulation

Confabulation may be defined as “falsification of memory occurring with clear consciousness in association with an organically derived amnesia”. These are false memories due to a retrieval problem, where the patient is unaware that he/she is confabulating, and has the belief that the memory is true. Spontaneous confabulations are bizarre and mostly implausible and tend to occur without any prompting. Provoked confabulations on the other hand occur in response to questions which try to elicit memory that is faulty. Neuropsychological evidence suggests, in most of the studies, at least a certain grade of memory dysfunction and executive dysfunction underlies the formation of confabulations. However, the specific characteristics of these neuropsychological dysfunctions are not well known.^[9]

CLINICAL ASSESSMENT OF MEMORY

Establishment of a full clinical history is the first and most important step in the diagnosis of memory disorders. On this eventually depends the plan that is to be followed to study the aetiology and most suitable treatment plan. It is useful to interview the patient and the informant separately. Interviewing the patient separately enables the cooperation and language skills to be assessed without them being masked by interruptions or assistance from a third party. It also allows an assessment into the degree of insight of the affected individual. The presence of word finding difficulties, paraphasic errors, and inappropriate behaviour can be assessed. Difficulties with specific aspects of memory are suggested by certain problems encountered in day to day activities. Anterograde memory deficiencies are suggested by the losing of objects, repetitive

questioning, difficulty taking messages, and an increasing reliance on lists, failure to follow plots of films or television programmes, and getting lost (navigation). Semantic memory breakdown may manifest as a diminution of vocabulary with words being substituted by “thing”. The meaning of unusual or infrequently used words may be lost. The level of alertness and cooperation during the interview should be assessed. If alertness is decreased, causes of this should be sought—for example, by a careful scrutiny of the drug history.

Important features to note in the history include :

- symptoms at onset
- the tempo of evolution of symptoms
- the impact on work and family life
- issues of safety (for example, driving)
- a family history of memory disorders
- risk factors—for example. vascular
- past medical history

Physical examination is useful and the presence of specific features may aid in understanding the aetiology and the diagnosis. Certain investigations are mandatory and additional tests are recommended if the history and examination indicate particular aetiologies. In the mental status examination, each aspect of memory (immediate, recent and remote) should be assessed in proper details which will enable the examiner: to distinguish the type of memory deficit (if any), the degree of memory loss, and the impact of the memory deficit on the patient’s ability to function.

IMMEDIATE MEMORY OR IMMEDIATE RECALL

Immediate Memory or Immediate Recall is usually tested by digit repetition test. Here the patient repeats the numbers as read to him/her by the examiner.

Direction : Tell the patient I'm going to say some simple number, listen carefully and when I am finished say the number after me. The digits are presented in normal tone of voice at a rate of one digit per second. Care is taken not to group digits either in pairs (e.g., 2-6, 5-9) or in sequence that could serve as an aid to repetition (e.g., in telephone number form, 3768439). Numbers are presented randomly without natural sequences. Begin with two number sequences and continue until the patient fails to repeat all the numbers correctly.

Scoring : Normally a patient of average intelligence can accurately repeat five to seven digits without difficulty. In a non retarded patient without obvious aphasia, inability to repeat more than five digits indicates defective attention. Specific age-related norms for this task are also available.^[10]

RECENT MEMORY (ORIENTATION)

Orientation to place and time are actually measures of recent memory, as they test the patient's ability to learn these continually changing facts. If a patient is not fully oriented this alone suggests significant recent memory deficit.

Direction : Orientation or recent memory is tested in a sequence by asking the patient firstly about his name, age, date of birth; secondly the place where he is currently residing in terms of name of the place, kind of place and floor; city, state, country, his home address and lastly testing the time domain comprising of date, day, time and season of the year.

INDIAN ADAPTATION^[11]

1. कल आपने रात के खाने में क्या खाया ?
2. आज सुबह आपने नाश्ते में क्या खाया ?
3. इस महिने का क्या नाम है ?
4. आज कौन-सादिन है ?
5. कल आपसे कौन-कौन मिलने आया या कल आप कि सकिस मिलने गये ?

Scoring : Usually normal people score perfectly right in all these domains. Those who are not high school educated makes plus minus 2 days error in recalling the date and those who are above high school educated makes an error of one day plus minus in recalling the day.^[10]

Remote Memory

Tests for remote memory evaluate the patient's ability to recall personal and historic events. Personal events must be verifiable by a reliable source other than the patient and performance on the recall of historic information must be interpreted in light of the patient's pre-morbid intelligence, education and social experience.

Direction : Patient is asked personal information like place of birth, information about whether he/she had been to school or not, if yes its location, then same regarding work and vocation. Information regarding their family like the names of the family members, their ages etc.

INDIAN ADAPTATION^[11]

1. आपकी उम्र कितनी है ?
2. आपका जन्म कहाँ हुआ ?
3. आपकी शादी कब हुई ?/आपने नौकरी याव्यसाय करना कवसे चालु किया ?/आपने पढ़ना कब छोडाया हाई स्कूल कब पास किया ?
4. आपके सबसे छोटे बच्चे या भाई बहिन की उम्र कितनी हौ ?
5. आप इस विभाग में पहली बार अपने इस इलाज के लिये कब आये ?
6. पिछलि बार आप इस विभाग कब आये थे ?

Scoring : Personal information items are completed with approximately equal accuracy by both normal patients and patients with mild nonspecific brain damage. Although impaired performance is pathologic, this test does not efficiently differentiate among groups.

In eliciting historical facts the patient is asked to name four people who have been the Prime Minister during the patient's lifetime. The normal person should be able to accomplish this task without difficulty. A slightly more difficult task and one that is very frequently failed in patients with early Alzheimer's disease is asking the patient to name the last four or five Prime Minister's in proper reverse sequence starting with the current one.^[10]

New Learning Ability :

New learning ability refers to actively learning a new material (to acquire new memories). Adequate performance requires the integrity of recognition, registration of the initial sensory input, retention, storage of the information and recall or retrieval of the stored information.

Direction : The patient is asked to remember four words for example:- brown, honesty, rose, glasses (which are unrelated to each other). Mechanism of interference or distraction is used after presentation to avoid mental rehearsal and ultimately ask him to recall presented words after five minutes to eliminate possible mental rehearsal. Subsequently recall after ten and thirty minutes is also done to check the duration of memory. During the test when a patient cannot recall a given word it is often possible to obtain an indication of memory storage by verbal cues. These include semantic cues relating to the category of the named object e.g. one word was a colour phonemic cues using syllabic components of the word e.g. hon... and contextual contexts e.g. a flower. If a patient cannot recall the words either spontaneously or with cues the examiner may resort to asking the patient if he or she recognises the appropriate word from a series of words (was the colour red, green, brown or yellow). When this yields significantly better results than spontaneous recall the memory problem may be due to a retrieval defect rather than to an acquisition or storage deficit. This demonstration of good memory on recognition

testing but memory on free recall is called implicit memory.^[10]

Scoring : The normal patient under age 60 should accurately recall 3 or 4 of the words after a 10 minute delay. Normal result for this test very significantly. The clinical implication of a low score (e.g. 2 of 4) must be interpreted in light of the patient's history and the performance on the entire examination.

Visual Memory (Hidden Object)

Visual memory should be tested in all patients, but it is especially useful in evaluating the memory of patients with aphasia.

Direction : Examiner uses five small commonly use items such as a pen, comb, keys, coin and spoon. The objects are then hidden while the patient is watching. After hiding the objects patient is engaged in general conversation for 5 minutes to avoid patient rehearsing the locations. After five minutes patient is asked to name and indicate the location of each of the hidden objects. If the patient cannot recall the location of any object ask him or her to name the hidden object.

Scoring : The average patient under age sixty should find four or five of the hidden objects after a five minute delay without difficulty. Older patient aged 70 to 90 will not do quite as well. Less adequate performance fewer than three objects indicates impaired visual memory.^[10]

Neuropsychological Tests

A more thorough and objective assessment of memory by means of neuropsychological tests should follow a clinical examination that reveals any impairments in the memory. The assessment can be done by means of various neuropsychological tests. Neuropsychological tests which exclusively test and assess the memory component of brain function are described below:

Sr. No.	Name of the test
1	Wechsler Memory scale III
2	Adult memory and information processing battery
3	Memory Assessment Scales
4	Recognition memory test
5	P.G.I Memory Scale
Tests of episodic memory	
1	Rey Auditory Verbal Learning Test
2	California Verbal Memory test
3	Benton Visual Retention Test-Revised
4	Luria-Nebraska memory scale
Test of semantic memory	
1	Pyramid and palm tree test
Test of working memory	
1	Visual pattern test
2	N-Back test
3	Self-ordered pointing test
Test of remote memory	
1	Autobiographical Memory Interview

MEMORY DISTURBANCES AND ECT

Electroconvulsive therapy (ECT) is an entails cognitive adverse effects, particularly the effects on memory. Electroconvulsive therapy may cause a temporary deficit in the cognitive processes of information encoding, consolidation, and retrieval. Transient memory disturbances are regarded as an inevitable adverse effect of therapeutic convulsions. Memory disturbances are seen occurring immediately after ECT and includes short lived impaired learning ability, defective retrievals along with permanent loss of memories of events (especially autobiographical memories) preceding immediately to ECT treatment. These deficits are proportional to strength of current, duration of electrical stimulus, number of sessions given to the individual, the area of the brain where the current pulse is given (dominant or non-dominant area of the brain) and finally bilaterality of ECT. Therefore,

ECT if applied unilaterally, in non-dominant side of the brain not only hastens recovery but also causes less post ictal amnesia, confusion and memory disturbances. However amidst various ongoing controversies regarding the ECT generated memory deficits the effects do not seem to last more than six months and some researchers currently have pointed out that ECT does not cause more than a temporary disturbance in memory.^[1]

COGNITIVE ENHANCERS

There are various drugs claimed to be having cognitive enhancing property but lack any definitive evidence. "Cognitive enhancement" is commonly associated with drug use or the use of devices to improve cognition, technologies that have on the whole been established in laboratory animals or through a history of use in humans to enhance cognitive function under normal conditions and the therapeutic strategies aimed at overcoming cognitive impairment.^[12] A large amount of mechanistic information is now available on the molecules that have been shown to improve cognitive performance in animals, and in some cases, in humans.^[13]

Examples :

Cholinergic activators : Donepezil, Rivastigmine, Galantamine, Tacrine.

Glutamate (NMDA) antagonist: Memantine

Miscellaneous cerebroactive drugs; Piracetam, Pyritinol, Dihydroergotoxine, Piribedil

Modafinil is a FDA-approved eugeroic that directly increases cortical catecholamine levels, indirectly upregulates cerebral serotonin, glutamate, orexin and histamine levels and indirectly decreases cerebral gamma-amino-butyric acid levels. In addition to its approved use treating excessive somnolence, modafinil is thought to be used widely off-prescription for cognitive enhancement.

CONCLUSION

As the state of our understanding of memory disorders continues to develop, currently the focus of interest is upon the conceptual issues that underpin memory formation, loss, and confusion. The various contributory causes, clinical symptoms and management of memory disorders is likely to garner increasing attention, in interaction with clearly neurological factors. Various progresses is being made through neuropsychological studies of patients, together with neuroscientific techniques – preferably employed in concert – resulting in better understanding of the causes of memory disorders.

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