Diagnosis and localization of memory disorders

Essay

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بسم الله الرحمـــــن الرحيـــــــم

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Introduction

Memory is an organism's ability to store, retain and recall information and experiences. There are three main stages in the formation of memory: Encoding or registration (receiving, processing and combining of received information), Storage (creation of a permanent record of the encoded information) and Retrieval, recall or recollection (calling back the stored information in response to some cue for use in a process or activity) **(Cowan 2001).**

It can be divided into: sensory memory, short-term or working memory and long-term memory. Sensory memory refers to the role of storage in the processes involved in perception, with the term iconic memory referring to visual sensory memory and echoic memory to its auditory equivalent **(Rugg & Wilding 2005).**

Short-term or working memory refers to the temporary storage of material necessary for performing complex tasks such as comprehension, reasoning and long term learning. There are three component of this type of memory: the central executive, an attentional controller that was aided by two slave systems, the phonological loop, and the visuo-spatial sketch pad .The phonological loop involves a store and a rehearsal process, with the store being reflected in the acoustic similarity effect as in the case of acquiring new words. The visuo-spatial sketch pad is assumed to be a system for maintaining and manipulating visual images. The central executive is the most complex and least understood component of working memory **(Baddeley 2003).**

One of the earliest measures of short-term memory is digit span, the longest sequence of numbers repeated back in the correct order. People vary in their span, but it is usually around seven digits or five random letters. The reason is that span is set by the number of chunks the subject can hold; word-like sequences can be broken down into memorable, typically pronounceable chunks **(Daniel et al. 2002).**

Chunking is an important underlying mechanism in human memory. With it, we learn more efficiently and become expertise in complex tasks such as chess. There are many studies conducted as some resources are pointed in the references of this post, but still there are many issues about chunking waiting to be investigated **(Gobet et al. 2006).**

Short-term memory is supported by transient patterns of neuronal communication, dependent on regions of the frontal lobe (especially dorsolateral prefrontal cortex) and the parietal lobe While Long-term memory is maintained by more stable and permanent changes in neural

connections widely spread throughout the brain. Hippocampus is essential for consolidation of information from short-term to long-term memory, although it does not seem to store information itself. Without hippocampus, new memories are unable to be stored into long-term memory, and there will be a very short attention span **(Ranganath & D'Esposito 2004).**

Long-term memory refers to more durable encoding and storage systems. Distinctions within long-term memory include that between episodic memory, the capacity to recollect experience, and semantic memory, stored knowledge of the world. There are a number of parallel systems that are capable of implicit memory **(Cabeza et al. 2003).**

Semantic memory refers to the system responsible for storing our knowledge of the world. It comprises not only the meanings of words, but large amounts of information that is not verbal in nature. Given the huge capacity of semantic memory, retrieving the right information at the right time represents a major challenge **(Tulving 2002).**

Retrieval depends on the method of encoding that based on meaning allowing rich and flexible storage and retrieval processes. Retrieval can be studied by means of retrieval cues, fragments of the original learning that can be used to evoke the learning experience. The context in which an event was learned will sometimes act as a powerful recall cue **(Cansino et al. 2002).**

Brain areas involved in the neuroanatomy of memory such as hippocampus, amygdala, striatum, or mammillary bodies are thought to be involved in specific types of memory. Hippocampus is believed to be involved in spatial learning and declarative learning, while the amygdala is thought to be involved in emotional memory **(Morris et al. 2006).**

Damage to certain areas in patients and subsequent memory deficits is a primary source of information. This damage to adjacent areas, or to a pathway traveling through the area is responsible for this deficit. Also, it is not sufficient to describe memory, and its counterpart, learning, as solely dependent on specific brain regions. Learning and memory are attributed to changes in neuronal synapses, thought to be mediated by long-term potentiation and long-term depression **(Stark & Squire 2005).**

The present study indicates that genetic variability in the human homologues of memory-related signaling molecules contributes to interindividual differences in human memory performance and memory-

related brain activations. Study of the genetics of human memory is in its infancy. A notable initial success was the association of APOE with memory dysfunction in Alzheimer's Disease. The first candidate for normal variation in memory is the gene KIBRA, which appears to be associated with the rate at which material is forgotten over a delay period **(Kandel 2003).**

Functional MRI during memory formation revealed that this genetic profile correlated with activations in memory-related brain regions, including the hippocampus and parahippocampal gyrus.Imaging techniques indicate that patients with Alzheimer's disease suffer from a loss of function of the hippocampal neurons, bilaterally, the cingulate cortex and the basal frontal areas. This implies that medial temporal lobe structures particularly the hippocampus and frontal areas are needed to select and store information in the long-term memory **(Amaral & Witter 2006).**

Data obtained from neuroimaging studies have shown activation patterns in the sleeping brain which mirror those recorded during the learning of tasks from the previous day, suggesting that new memories may be solidified through such rehearsal **(Fletcher & Henson 2006).**

Loss of memory is known as amnesia. There are many types of amnesia, and by studying their different forms, it has become possible to observe apparent defects in individual sub-systems of the brain's memory systems, and thus hypothesize their function in the normally working brain. Other neurological disorders such as Alzheimer's disease can also affect memory and cognition. Hyperthymesia, or hyperthymesic syndrome, is a disorder which affects an individual's meaning that he cannot forget small details. Korsakoff's syndrome, also known as Korsakoff's psychosis, is an organic brain disease that adversely affects memory **(Kirshner 2008).**

The term amnesia is typically applied to a deficit of long-term episodic memory, involving an impaired capacity for or new learning (anterograde amnesia), and/or adeficit in access to old memories (retrograde amnesia). Both are likely to cause major problems in everyday functioning. Causes of amnesia include traumatic brain injury,brain infection, stroke and alcoholic Korsakoff's syndrome.The classic amnesic syndrome involves impaired episodic memory, but with preserved intellect, normal working memory and access to semantic memory, although new semantic learning is likely to be impaired **(Knopman 2007).**

People can improve cognitive function and brain efficiency through simple lifestyle changes such as incorporating memory exercises, healthy eating,

physical fitness and stress reduction into their daily lives. There are a loosely associated group of mnemonic principles and techniques that can be used to vastly improve memory known as the Art of memory. The International Longevity Center released a report which includes recommendations for keeping the mind in good functionality until advanced age. Some of these recommendations are to stay intellectually active through learning, training or reading, to keep physically active so to promote blood circulation to the brain, to socialize, to reduce stress, to keep sleep time regular, to avoid depression or emotional instability and to observe good nutrition **(Silverman et al. 2006).**

Aim of the work