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# Method of brain memory functional networks

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**Abstract:** The study of brain science is one of the difficult problems of human scientific research, and memory is one of research hotspots of brain science. In the past, the focus is the structural research for memory, and the functional research is becoming the focus for memory now. In order to provide effective reference for memory research, we summarized the methods in our study on brain memory researches where the functional research is emphasis. Meanwhile, we put emphasis on memory networks and discuss the results and conclusions. We believe the methods of brain memory functional networks can provide the help and reference for memory researches.
**Keywords:** Brain memory functional networks; Psychology; fMRI; Computer simulation; Complex networks.

## INTRODUCTION

Brain research is one of research hotspots and difficulties in scientific researches [1-3]. Up to now, many experts and researchers in all kinds of areas have done a lot of attempts and efforts to recognize human brain, including the structure and functions. Memory is one of brain functions and has gotten a lot of researches focus from psychology to medical science, especially in neural biology and cognition [4-6].

With the developments of science and technology, memory is not a single department belonging to a subject. It has reached a consensus that it is necessary to use synthesis and crossover methods to recognize the memory of human. In the past, the experts and scholars focus on the structural research on memory. With the help of clinical researches, the structure of memory has been recognized thoroughly and detailed step by step. Based on the structure of memory, the function of memory also has gotten many achievements, especially in the network view [7-10].

In the process of memory researches, the method is vital to the results and application. Method can provide the conduction for research and application, also can reference and help for technology and behavior [11, 12]. In memory researches, every attempt or effort to find the secret of memory is valuable and meaning whether it is right or not because of the particularity of the research object. So we decide to summarize the methods for memory researches, not the review.
In our paper, we summarized the general methods for memory researches combining our study on memory networks. In methods paragraph, we display the methods for memory researches. In results and discussion, we list the typical results and discuss the results. At last, we make a short conclusion of our study and paper.

## METHODS

Since human beings have been there, the memory always follow and serve the people. In the 6th century BC, memory had been put forward with forgetting and it was looked on as the mixture of heat and cold. Until the 17th century, there was little progress in memory research. But the professional study of memory originated from psychology, especially from association psychology when Rock, Hobbes put forwards the association. The first systematic experiment in the history of psychology was H. Ebbinghaus, a famous German psychologist. He measured the memory quantitatively and put forwards Ebbinghaus forgetting curve with the conduction of memory maintaining rules. From then on, then memory researches became the important field of psychological research [7-15].

Now humans continue studying the research of memory, and it is still a long way to uncover the memory puzzle thoroughly even the science and technology have made great progress. Except exploring the internal mechanism of the memory, more of our talking in memory refers to the methods, techniques, uses and services of memory in practice which can improve the efficiency of our work, life and study [13, 16].

With the development of science and technology, especially in medicine science and technology, memory has made great progress from clinical requirements. Object to memory in clinical research and remedy [13-17], experts and researchers achieved many results. From the basic inference and experiments in medicine, memory researches have experienced a process from structure to function, though the focus was function in the past. Since the structure has been uncovered, the memory research gradually entered a new stage of research.

Based on the structure, many functions of memory have been discussed. The focus of memory researches becomes diversification, including the memory characters, memory types [1-3,12-15], and so on. In clinical, the disease of memory promoted the development of memory research, especially the technology development of clinical diagnosis in radiation field. From the initial X rays, including angiography, computerized tomography, and radiography, it provided a wide space for memory research. Based on the X-rays, gamma camera, positron emission tomography, single photon emission computed tomography was applied to brain research, of course, memory [10-18]. In recent years, the breach in the time complexity and space complexity provided an excellent way to explore the brain structure and function. Magnetic resonance imaging, medical ultrasonography, endoscopy and so on were applied to the research of memory, sometimes combing with the fluorescein angiography, microscope, Photoacoustic imaging and thermography and so on.

With the medical imaging technology, memory research can be made from structure to function [1,7, 19]. More and more functional structures were reported with X-ray, computerized tomography, magnetic resonance imaging, ultrasound, positron emission tomography, electroencephalogram and magnetoencephalograph. With the functional magnetic resonance imaging, memory has been made to many valuable networks.

Due to the specific characteristics, the brain can't be tested by researchers. In order to find the structure and function of brain, including the memory, computer simulation was a successful way to explore the memory. By the computer simulation, we can simulate the brain as any structure to discuss our finding whether on the theory or on the application as long as it is reasonable. Based on a large number of assumptions, memory was discovered to be all kinds of networks [1,20].

With the rise of complex networks, memory was looked on as functional networks of brain and got many meaningful results. Complex network is a kind of comprehensive cross discipline; it uses the technologies of computer, control, mathematics and physics to explore the real world. In complex network, every real system is regarded as a network by the node and edge. With graph theory and control dynamics, every network is computed from quantity [1-7].

With above methods, it is well know that memory is a functional networks of brain. In recent years, memory research has combined all of them to explore the secret of memory.

**RESULTS AND DISCUSSION**

From psychology, memory has different types and processes. In the beginning, instantaneous memory comes with short time [15-20]. By the transient memory of attention for a long time, such as deliberate to stare at a few eyes, it entered a short-term memory, also the working memory. If we repeat or recite the information in our mind, it goes into the long-term memory, and at work, information is extracted from long-term memory, and it is used to work in the short-term memory.

Memory has achieved a lot of results in psychological research involving many fields, such as perception, cognition, emotion, personality, behavior, interpersonal relationship, social relationship, and so on [3,7,21-23]. It is also related to many areas of daily life, such as family, education, health, society and so on. Psychology attempts to explain individual behavior and psychological function in brain function of memory. At the same time, the psychology attempts to explain individual psychological function in social behavior and social dynamic role; at the same time it also is related with neural science, medicine, biology, and other science, because the science of exploring the physiological role will affect the individual's mind.

In clinical, doctors and researchers has done a lot of work for memory and found many results of memory [1,3,7,24]. For example, just before the injury events are only temporarily stored in memory, and will be quickly forgotten, so the memory is not transferred to long-term memory. Patients with epilepsy can remember the past things without damage after removing the hippocampus from the brain, but it is difficult to remember new things which verified that hippocampus is an important area for memory function. Except that, Central temporal lobe, diencephalon, prefrontal lobe, amygdala, basal nucleus of Meynert and marginal division of the strialum are also the area of memory.

In computer simulation, all kinds of memory models have been put forwards [5-8,12-14]. The representative model is the three-level information processing model. In fact, before short-term memory, people firstly perceived to acquire information from the outside world. This is a representative model of the multiple storage models, which is divided into three types: sensory memory, short-term storage and long-term storage. In the model, the memory and memory

storage is distinguishing in the concepts. The former refers to maintaining information, and the latter refers to the structural components of the memory information, that is, the current feeling of memory, short-term memory and long-term memory.

In complex networks, combing with memory structure, memory was a kind of functional networks of brain [1,25-29]. The cortex or the neurons are the node, and the physical connection or the functional link are the edge, so the memory formed the functional network of brain. Many functional networks of memory were gotten with electroencephalogram or magnetoencephalograph data and sometimes were used in patients. From the reference, we can get that memory network is a kind of small world network with high efficiency.

## CONCLUSION

In this paper, we summarized the methods of memory research on functional network. Based on the references, we can conclude that the method of memory research is a comprehensive and cross way with multi discipline. For brain, it is a fine and complex difficulty to recognize thoroughly, and memory is one of its functions, so the research of memory can't do without combination of multidisciplinary integration and cross, such as psychology, clinical medicine, computer, physics, complex network, and so on. Of course, molecular biology, physiology and biochemistry are also important tools for memory discovery.

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