The Impact of Autism on Children's Memory

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Abstract. Much evidence showed that most autistic individuals had defects in executive function. These defects are more obvious in children. Among them, the influence of memory is widely concerned. The spatial working memory, episodic memory, and autobiographical memory of autistic children have been significantly affected. Although some memory performance of autistic individuals is not good, they still retain part of the complete memory system. The differences between autistic children and healthy children may change over time. There are also significant differences in memory performance between autistic children and adult autistic individuals. Due to the plasticity of the brain, the poor memory performance of autistic individuals can be improved through some training. This study aims to compare the memory system of autistic children, adult autistic individuals, and healthy children. Based on previous studies further show what impact autism will have on children's memory. The causes of these impairments and what training can improve the executive function of autistic children.

Keywords: Autism; working memory; verbal memory; short-term memory; long-term memory.

1. Introduction

Autism is a mental disease caused by genes and environment. People with autism usually have repetitive behaviors, developmental disorders, and a single interest [1-3]. With the development of psychology, people have a deeper understanding of autism. In the past, many studies have shown that the memory of children with autism will be affected. For example, children with autism had a worse performance in recalling details [4]. However, these children's memory performance is not only affected by autism. IQ and brain development also affect the memory performance of people with autism [5]. People also are aware of the impact of autism on different types of memory. However, most studies only focus on the impact of autism on a specific memory type. They lack a comprehensive comparison. This study integrates the effects of autism on the memory of affected children on the basis of previous studies. It not only compares the impact of autism on children's memory and adults' memory, but also compares the difference between an autistic child and healthy children. All autistic individuals have certain defects in detail recall. However, under the condition of normal intelligence, some poor memory performance of children with autism may be caused by an immature brain memory system. This phenomenon will gradually disappear in adulthood. Compared with healthy children, autistic children have certain challenges in recalling complex visual and linguistic information. However, this does not mean that their learning ability is lower than that of healthy children. In addition, it also collects some methods to improve the executive function of autistic children through memory-related training.

Previous studies have shown that autism can affect people's working memory system. It also affects people's learning skills. When the working memory system is incomplete, it is not only difficult for people to remember and process some complex information. Moreover, it is hard to concentrate on one thing [6]. Research on the memory system of autistic children can help them improve their learning ability and living ability. Therefore, this article aims to review the influence of autism on children's memory.

2. Method

This article collected much autism-related research through Google Scholar, Web of Science, SAGE, and ProQuest. Researchers divided these studies into three categories: (1) research on the

memory system of autistic children and adults; (2) research on the memory ability of autistic children and healthy children, and (3) How to improve memory of autistic children. Subsequently, the collected papers were sorted out to systematically describe how autism affects children's memory and how to improve the memory of autistic children.

3. Literature Review

3.1 How Does Autism Affect Children's Memory Compared with Autistic Adults

Autistic individuals have specific defects in the memory system. Among these individuals with autism, there are obvious differences in memory performance between adults with autism and children with autism. The impaired memory system of each autistic individual may be different. The impaired memory system may also change over time. Bennetto and his colleagues compared the executive function (EF) between healthy children and teenagers with autism in 1996. [7]. EF refers to a bottom-up psychological process. It includes inhibition of distractor attention, working memory, and flexible cognitive function [1]. Executive function damage will bring many negative effects to life. For example, the IQ, memory performance, and mental state of individuals with impaired EF may be inferior to healthy individuals. The result suggested that teenagers with autism have some defects in executive function. They had worse performance in order memory, source memory, and working memory. This makes it more challenges and slower for them to learn knowledge and skills than healthy individuals. In general, the cognitive function of autistic children is incomplete. Therefore, these children with autism of learning ability are also significantly worse than the healthy group. This disorder has brought more difficulties to their development.

Compared with healthy individuals, the performance of semantic memory and episodic memory in autistic children is also inferior to that of healthy children. Their understanding of general world knowledge that encompasses memory for concepts, facts, and the meanings of words is inaccurate. They also seldom mentioned emotion-related memories in their memories of long-term events, but this did not occur in their memories of recent events. This may be due to the defective EF of autistic children. The integrity of some memory functions shows that autism does not affect the entire memory system. Some memory functions such as executive function and memory performance can still be retained.

Another study also suggested that some adults with autism perform worse in recalling specific details and thematic information. Although autistic children are not as good as healthy children in detail recall, their performance is better than that of adults with autism [4]. Their study showed that the expression ability of teenagers and children is not fully mature, and there is no obvious difference between children with autism and healthy children in the expression of episodic memory. With age growth, healthy children's language ability continues to improve. In adulthood, healthy individuals will recall episodic memory much better than adults with autism. However, there are individual differences in memory between an adult with autism and a child with autism. Autistic individuals use different memory types to process information in memory tasks. Not all autistic individuals are significantly different from healthy individuals.

Williams and his colleagues used Wechsler Memory Scale III to test adults with autism but without intellectual disability [8, 9]. The results showed that they had no obvious impairment in working memory, the memory of recent events, and verbal memory. However, their spatial memory and visual memory are not complete. For individuals with autism, both adults and children can have normal story recall performance when their brains are mature and their IQ is normal. Nevertheless, adults with autism do not recall the details of the story, as well as children with autism. Therefore, IQ and brain's development are both important factors affecting memory ability. Although there are some differences in memory ability between adults with autism and children with autism, this difference may disappear with time.

3.2 How Can Memory of Autistic Children be Affected Compared with Healthy Children

Autism affects children's autobiographical and spatial memory. Due to children's brains are immature; the difference of memory performance is more significant in young individuals. Nevertheless, not all types of memory in autistic children are defective. Their different memory systems work for them independently. Some studies have shown that although the autobiographical memory of autistic individuals is incomplete, other memory system also can work normally [10]. Autobiographical memory is the memory of specific personal information, including personal information such as name, age, address, and some memories of personal experience. In this study, researchers found that autistic children need more cues than healthy children to recall some experiences. And they will be more difficult to recall the details of these experiences. Their memories of personal experience are usually incomplete and inaccurate. However, there was no significant difference in other memory systems between these autistic children and healthy children.

In addition to autobiographical and spatial memory, the episodic memory system of autistic individuals is significantly different from that of healthy individuals. Boucher's study suggested that individuals with autism are not good at recalling recent events in detail [11]. In other words, they did not have an excellent performance in episodic memory. Episodic memory refers to the ability to recall past events. It includes some personal experiences, emotion, feelings and our relationship with others This may also explain why some autistic individuals cannot express their feelings about some experiences in complete language. And the memory deficits of autistic children have nothing to do with their poor intelligence. Some people believe that the poor performance of autistic children in memory tasks may be due to impaired language function rather than the memory system. However, the evidence in this study shows that this is not the case. There was no significant difference between autistic children and healthy children in the cue recall task. Because the nonverbal ability of these children has not been accurately measured, the reason for poor memory performance is not clear. A study on the hippocampus of individuals with autism also supports this conclusion. In the brain of autistic individuals, there is no significant difference between the activity of each region and that of healthy individuals. However, their brain regions are poorly linked [10]. For example, they have the hippocampus and the posterior parietal cortex [12]. The temporal cortex is not well connected. Links in these areas have a great impact on memory performance. Poor links will cause individuals to not recall their experiences well according to the context. At the same time, the difficulty of processing complex information will also increase. In addition, previous studies have found that autistic children perform worse in phonological working memory than control children [13, 14].

The learning ability of autistic children is not worse than that of healthy children. Nevertheless, the incompleteness of the memory system may affect their learning performance. Millward and his colleagues conducted an experiment on the memory of autistic children in 2000 [15]. They let two groups of children aged about 12 pass through 5 different places. These children will experience an event in these different places. The experimenters then asked the children to recall their experiences in these places. The results showed that children with autism performed worse than healthy children in recalling the events they experienced. Williams and his colleagues conducted a clinical memory test on autistic children and healthy children[16]. The language ability and intelligence quotient of these children are at a normal level, meeting the experimental requirements. The experimental results show that autistic children have difficulty in remembering some complex visual and linguistic information, and their spatial working memory ability is lower than that of healthy individuals. In autistic children, spatial working memory and visual working memory are separated. Their experimental results showed that some children and adolescents with autism had no significant difference from healthy individuals in the performance of phonological working memory tasks. These findings are consistent with those of previous studies. However, the completion of visual working memory tasks was significantly lower than that of healthy individuals. Because the language system development of autistic children is not complete, these differences are more significant in children. But there is no significant difference in the learning ability of autistic individuals.

4. Future Directions

However, the memory deficits of autistic children are not insurmountable. Studies have proved that physical and mental training can improve the executive ability of autistic children and then improve their memory. Because the brain is plastic, neurocognitive enhancement can be applied to treat some diseases and improve the cognitive function of patients by taking some drugs or training [14]. Chan and his colleagues conducted a study on the training of autistic children in 2014. The study asked 46 autistic children to carry out NeiGong exercises for a month. It means that through a series of gentle movement exercises, these children can achieve inner peace, relaxation, and flexible limbs. Children's inhibition control ability improved after practice. In the EEG, the anterior cingulate cortex was also more active than before. The ability to recall events was also improved. In the study conducted by Chan and colleagues [17], they conducted NeiGong training for autistic children who passed intelligence assessments with the informed consent of their parents. The results showed that the memory retrieval ability of autistic children was enhanced. They will use more strategies to help themselves recall more information, and the executive function of information processing is better than before. The improvement of memory ability of children with lower intelligence levels is more significant. Moreover, due to the improvement of executive function, these autistic children may perform better in other aspects of learning.

In addition to related physical and mental training, some puzzle games have also been applied to the treatment of autism. In recent years, game-based working memory training has been successfully practiced in autistic children [18, 19]. In this game, some objects with specific shapes and colors are displayed. Sometimes they also appear in some special places. Children need to remember this special information to complete the task. The results showed that the working memory of children with a training cycle of about one month did not improve significantly. But autistic children who performed well in games were more likely to improve their working memory. If autistic children are given long-term working memory training, their executive ability and memory abilities are likely to be greatly improved [20, 21]. Therefore, whether it is some memory-related intervention training or physical and mental training, they may improve the memory function of autistic children. The impairment of the memory system in autistic children can be changed.

5. Conclusion

All in all, these studies show that autism affects children's memory systems. Most studies have shown that autistic children have limited abilities in autobiographical memory, spatial working memory, and episodic memory. However, the voice memory system is separate from them and is not necessarily damaged. These impaired memory systems can also affect children's performance in other executive functions. Through some physical training and memory game training, the memory performance of autistic children can be improved. However, the symptoms of these memory impairments still have large individual differences, and the reasons for these differences are still unclear. Therefore, there is no intervention that can be applied to all autistic children. In the future, researchers will further study individual differences and separate different memory systems and design a set of intervention programs with strong applicability for autistic children.

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