The Benefits of Working Memory Training

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Abstract: Researchers conducted training on the four subsystems of working memory with different research paradigms to explore the role of working memory training in a specific field and the migration effect. The training of working memory can promote the individual's cognitive development under some mechanism. In terms of the effect of the training of working memory, this paper will elaborate and analyze from education and clinical fields.

1. Introduction

Working Memory (WM) is a limited-capacity memory system that temporarily processes and stores information and plays an important role in many complex cognitive activities The working memory model believes that working memory and short-term memory are different. Working memory is not a system composed of a single component, but a model composed of multiple components. It consists of the Central Executive System (Central Executive), the most important but the least studied system of working memory. [1]It is a limited-energy system that functions to be responsible for the connections between subsystems and their long-term memory, as well as for the selection and planning of resources and strategies. The Phonological loop is responsible for the storage and control of sound-based information, including voice storage and pronunciation control. Part of it is voice storage that keeps voice messages. The other part is the vocal control, similar to the internal language, which can reactivate the retired speech representation by silent reading to prevent the recession, and the pronunciation control processing can also convert the written language into the voice code. There is a "speech storage" view Visuo-spatial Sketch) The episodic buffer is a device with a limited capacity for temporarily storing a variety of encoded information. It is controlled by the central execution system, and the central execution system can extract information from storage and reflect information through consciousness. The information can be corrected when necessary. The Visuo-spatial sketch primarily deals with visual spatial information. Like a voice loop, information can go directly into the visuo-spatial sketch or indirectly. The visual space template subsystem is important for the planning of spatial tasks and the orientation in the geographic environment. Episodic buffer: Baddeley adjusted the original three-component working memory model, adding a new component, the scene buffer, and constructing a new four-component working memory model. The episodic buffer is able to integrate information from various sources. The source's limited capacity temporary storage system. Controlled by a central execution system, the central execution system can retrieve information from memory in a conscious manner and review and modify it as necessary[1]

2. Working memory training and methods

Working memory training refers to the training of low-Working memory capacity individuals in the storage system or the components of the central execution system to improve individual working memory performance and activities affecting task-related brain regions[2]. Previous studies have shown that working memory training has an important impact on psychometrics and the nervous system. The training of cognitive tasks and working memory tasks can improve the performance of training tasks and the performance of some untrained tasks[3]

2.1 Explicit and implicit training tasks

In the existing study of working memory training, the scientific nature of training methods is the core influencing factor of the improvement of working memory performance. In summarizing the previous research, the working memory training can be divided into explicit task training and implicit task training according to the working memory training task type. Implicit training means that the subject is not allowed to know the relevant memory method. Implicit training is not directly taught to the test memory strategy, but by simply repeating the task, gradually adjusting the difficulty of the task, and feeding back the results of each training. The trainer thus gets an improvement in memory scores[4].

2.2 Central Executive System Training

The central execution system's ability to suppress means that the brain assigns attention to relevant information and processing during cognitive operations, and maintains suppression of irrelevant information[2]. Johnstone, 2010, examined whether working memory and inhibition training can improve the condition of children with ADHD. The results showed that compared with the low-intensity group, the high-intensity group had inattention and hyperactivity. Improved[5].Refreshing is the process of replacing the old ones in the working memory with the newly generated stimulating content, realizing the replacement of information to match the current task requirements, and the training of refreshing ability generally adopts the N-back task [6]. Zhao Xin et al. used the activity memory paradigm for refreshing ability training for children aged 9 to 11 years. The task required children to watch a series of stimuli of unknown length and then recall the stimuli according to the specified number[7]. It was found that the children in the experimental group not only improved their performance in the work memory task, but also improve the fluid intelligence.

3. Different fields of working memory training

3.1 Research in the field of education

The training of working memory involves different fields, playing an irreplaceable role in cognitive development, learning, etc., and is also widely involved in different disciplines in education. Dahlin, KIE surveyed 57 people in Sweden in 2011. The relationship between the working memory and reading performance of primary school students with special needs, the research results show that working memory training can promote the development of children's reading comprehension ability. Working memory methods are related to children's vocabulary reading and reading comprehension. Working memory is a key factor in the development of children's reading ability with special needs. Interventions to improve working memory can help improve the reading comprehension ability of children with special needs[8].Loosli et al. 9-11 years old children underwent computerized adaptive working memory interventions. In the trained working memory test, children significantly improved their working memory ability. Compared with the group, the experimental group's working memory ability was significantly improved. The reading scores after training provide a basis for the sharing process between working memory and reading[9].In the field of bilingual studies, Coleman, B. P examined the impact of working memory training on the working memory ability and second language ability of Spanish adult learners. He pointed out that the working memory training group did not show up with the control group in the evaluation of working memory. Better than the improvement, but the self-defined reading task does show more localization patterns, even if not necessarily improving their working memory ability, may help learners learn to learn a new language related increasingly Increased processing needs[10]

In addition, Takeuchi studied the returning working memory for adaptive training, which improved the cognitive ability of speech letter span and complex arithmetic tasks, but reduced the performance of creative tasks, which may be due to psychological computing to strengthen adaptive training after working memory. The selective attention to system changes, research shows that creativity and the selective attention system have a positive relationship, this system does not allow unnoticed information to be filtered out[11]. Some researchers believe that low working memory may be the core defect of ADHD patients. In 2014, Coleman, B. P. examined the effectiveness of working memory training on real-world attention performance. Fifteen children aged 6-15 years old with learning and attention problems were selected as subjects, and they were evaluated before and after completing the 5-week working memory training. It was found that in real-life situations (classroom learning), working memory training made continuous attention. Significant improvement in strength, mainly in the absence of missing errors, reaction time and accuracy. Therefore, computerized working memory training may be a viable option for treating attention disorders.

In order to investigate the influence of the baseline level of fluid intelligence on the migration effect of working memory training, Zhu et al. used a visual and auditory dual task to train the training group for one month, and the active control group used the reading task for training. The greater the amount of working memory training, the greater the fluid intelligence improvement value. The fluid intelligence baseline level, the working memory training boost, and the product of the two together affect the fluid intelligence improvement value. This result suggests that individual differences such as fluid intelligence levels[12]. Fuchs randomly divided risk children into control groups, general working memory training groups, and strategy-directed training groups. It was found that the performance of speech work memory training for children in the two training groups was improved[13]. Working memory training with metacognitive strategies for children with special educational needs can improve their working memory performance more than regular working memory training, and the benefits migrated to 6 months later [14].

3.2 Research in the clinical field

With the continuous development of society, the problem of old age has become the focus of society, such as loneliness, dementia, memory loss, cognitive aging and other issues, many researchers are committed to the study of the elderly. Buschkuehl, M. and others believe that as the age increases, it poses more objective and subjective problems for memory disorders. The 80-year-old adults are trained twice a week for three months, and one year after training. Before and after the test, the improvement of visual work memory performance is particularly obvious, and the visual situational memory is also significantly increased[15]. This shows that the training of working memory helps to improve the memory of the elderly. Therefore, the solution to the memory problem of the elderly can start from effective working memory training. In 2010, Hikaru Takeuchi used a voxel-based morphological analysis of fractional anisotropic fiber bundles to conduct an interventional study on the effects of working memory training structure connections. It was found that working memory training increased the white matter area and corpus callosum in the parietal region. The structural integrity of the area, both of which are considered to play an important role in working memory, and these changes are unlikely to be explained by the effects of normal development or other factors, as structural integrity is related to the amount of tasks improved and working memory training[16].

Alcohol intake has always been a concern of the community. For example, drunk driving, alcoholism, and alcohol addiction all endanger the safety of individuals and society. How can alcohol intake be reduced on these issues? Katrijn Houbended 2011, etc. The Year of the People proposes that alcohol abuse can undermine core executive functions, including the ability to maintain and manipulate target-related information, including working memory. They believe that when executive functions such as working memory are weakened, drinking behavior is out of control and is strongly guided by automatic pulses[17]. Katrijn believes that working memory training can restore the control of drinking behavior, select 48 problem drinkers to complete working memory training tasks within 25 days, working memory and drinking behavior before and after testing. One month after the training, it was found that the training of working memory improved the working memory and reduced the alcohol intake. Through the indirect influence of

the working memory training on the "automatic pulse level" of the alcohol user, the improved working memory ability can be reduced. Alcohol consumption by strong alcohol preference. These findings are consistent with the theoretical framework and demonstrate that increasing the control of automatic pulses through working memory training to reduce alcohol consumption may be an effective strategy[17]. Other studies have shown that working memory training improves the performance of working memory in certain indicators of methadone maintenance patients and may affect drug use results. Working memory training has been shown to be prospective in patients with drug use disorders, but further research is needed to understand which mechanisms can improve working memory and influence drug use outcomes[18].

4. Discussion

The result of most researchers' work memory training is that the corresponding work memory training task scores are relatively improved, but whether the improvement of this training score can really migrate to the object to be studied, although there are several A successful training paradigm, but the scope of the migration effect is still uneven. Morrison and Chein believe that the observed increase in working memory training scores should be explained by the different effects of participants' expected input levels, rather than the effects of targeted and targeted cognitive processes. Some studies may have a placebo effect in order to achieve the desired effect[19]. Simply put, researchers believe that working memory training should have a positive impact on cognition and may explain the effects of post-training expansion. Some researchers have emphasized the need for careful interpretation of the N-back dual-task training study suggests that Buschkuehl and Jaeggi suggested that it is necessary to replicate and extend previous studies[21]. Therefore, different interpretations of the results have emerged, and more scientific and reasonable evidence is needed to support this.

The above studies have provided important theoretical guidance for understanding the plasticity of working memory and the design of effective working memory training programs, but there are certain problems: Specifically, does working memory training produce a broad cognitive enhancement? As far as working memory training is concerned, different training methods do improve on various cognitive domains (eg, fluid intelligence, cognitive control, reading comprehension), and consistent with neuroimaging studies, therefore, working memory training is a future study and needs to clarify the specific mechanisms that produce training benefits. Previous researchers have been commended for their promotion of working memory training, and have provided us with important research evidence, but there are still many other problems to be studied by latecomers: If the amount of training in working memory needs to be trained, can the migration effect occur? Will the migration effect of working memory training decline or disappear over time? Is the working memory "maintenance" plan useful for maintaining training effectiveness? What are the criteria for working migration training to produce migration effects? Can different training paradigms be combined to have a greater impact on cognitive performance? Fahimi, M research and development of working memory training software has good psychometric characteristics, can significantly improve students' work memory performance [22].

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