学位論文の要旨

Abstract of Thesis

研究科 School	自然科学研究科
専　攻 Division	生命医用工学
学生番号 Student No.	51428653
氏　名 Name	GUO TING（郭　婷）

学位論文題目 Title of Thesis（学位論文題目が英語の場合は和訳を付記）

Psychological Studies on Visual Working Memory Training in Healthy Adults
(健常者における視覚作業記憶の訓練効果に関する心理学的研究)

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Working memory refers to the cognitive capacity to temporally store and manipulate sensory information from multiple sensory domains. It is an important cognitive device for higher order cognition and were widely used in human's daily life. Recent research shown that the decline of working memory were related `with aging effects or caused by cognitive disorders. Current study focus the association between working memory and the aging effect in both temporal and spatial domains. Moreover, we attempt to improve the performance of working memory by behavior training for younger and older participants.

Firstly, to investigate the main cause of aging effect in visual-spatial working memory, we modified the visual spatial task to evaluate the processing speed and item capacity of visual spatial working memory for 29 younger and older subjects. Our participants need to remember a sample spatial memory array and compare it with test arrays. We calculated the capacity and processing speed of visual working memory in both aging groups. We found that in sufficient time condition, older participants also could complete the task which had higher memory capacity. Moreover, there has a significant difference in response time between younger and older groups. Our results concluded that the processing speed is a more important cause of aging effect than storage ability of working memory. And we further speculated that the older participants could defer cognitive decline by training the processing speed.

Secondly, we focus on whether the order of present time for memory array can improve the performance of visual spatial working memory. Furthermore, we are more concerned about how the internal representation was manipulated by temporal orders, so we selected retro-cue paradigm to direct the attention in serial memory arrays.

Name	GUO TING（郭　婷）

We recruited 72 participants divided into two sub-groups randomly to execute color and shape change detection tasks. In our experiments we presented two consecutive spatial memory arrays, and used order-cue to direct the attention of participants on the first or second memory array. Our results confirmed that temporal order-cue can improve the performance of visual spatial working memory. Provides more evidence for the temporal and spatial correlation of working memory.

Thirdly, we presented evidence of transfer from tactile working memory training to spatial and temporal visual working memory tasks. We recruited 32 participants divided into two sub-groups randomly to participate training and control experiments. We used a tactile orientation sequence task to train the participants' tactile working memory for two weeks, and we used visual temporal sequence and visuospatial working memory tasks as pretests and posttests to evaluate the training effect. Our results showed that accuracy on the tactile working memory task increased due to the two weeks of training. Remarkably, accuracy increased for both the visual temporal task and the visuospatial task in the training group. These results suggest that it is possible to improve visual spatial and temporal working memory through a transfer effect from tactile task training without practice in the visual domain. This opens a wide range of applications for tactile orientation sequence tasks.

Lastly, we aims to compare the training effects of working memory with temporal sequence in younger and older participants. To achieve this purpose, we recruited 42 younger and older adults who were divided into two sub-groups randomly to participate the current experiment. We executed a visual orientation discrimination task and a modified visual orientation sequence tasks to train the visual working memory for all participants, and evaluated the training effects by comparing results of the same pre and posttests. Our results showed that both younger and older participants could benefit from the designed training tasks. These findings indicated the robust plasticity of working memory even in aging brain, and our results further suggest that more effective training gains could be achieved by adjust the difficulty of training task for participants with different cognitive ability.

According to the current studies, we summarized the influence of aging effects in temporal and spatial visual working memory. We designed behavior training task for temporal working memory, and found significant training effects for visual working memory. Furthermore, we have observed the transfer of training effects between tactile and visual modality. Additionally, we highlight that the temporal order-cue can improve the performance of visual spatial working memory.