



Finger Dexterity and Attention in the Elderly

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Abstract. Based on Rabinowitz et al. pointed out that there is an association exists between finger tapping and attention. The proposal study was based on the previous study and increased the speed of finger tapping to test the effect of finger dexterity on the attention of older adults. In this work, we tested whether finger exercise will be able to improve the attention span of the older person by the way of increase the speed of finger taps. We also tested whether the faster the tapping of the fingers, the better the attention span of the older person.

Keywords: Attention · Finger Tapping · Short term memory · Finger Exercise · Digital Span Task

1 Introduction

1.1 Background

Fingers are an essential part of the human body and they play an important role in people's cognition. As people get older, their organs begin to decline. The dexterity of the fingers also declines as people become older. Older participants tapped their fingers more slowly than younger participants [1]. However, the previous study mentioned that finger dexterity can be improved through finger exercises [2] and could have cognitive benefits. According to Nursing effects of finger exercise [2] on cognitive function for cerebral ischemic stroke (CIS) patients. Cerebral ischemic stroke (CIS) is one of the most common types of stroke (CS), and one of the major diseases causing disability in China. Li et al. suggested that based on early nursing rehabilitation, combined with finger movement training can improve cognitive function. When caring for elderly patients, incorporating finger exercises [2] during treatment helped patients recover [2].

Finger activities increased finger dexterity and provided cognitive benefits to older adults, but this study did not indicate which aspect of cognition was affected. Based on Temporal measures of human finger tapping: Effects of age, the positive correlation between age and the average response initiation time reflects age-related effects. There was a significant increase in mean response time with increasing age. The study showed that it is possible that the longer mean response times exhibited by older participants reflect the fact that they have more difficulty switching responses than younger participants [3]. This study on finger tapping experiments showed a positive relationship

between human reaction time and age and based on Novikov et al. suggested that the slow response was associated with a state of decreased attention [4].

Additionally, in the study, association between finger tapping, attention, memory, and cognitive diagnosis in the elderly, Rabinowitz et al. pointed out that there is an association between finger tapping, working memory, and attention in older adults. The study implied that longer and more variable finger touch phases are associated with poorer attention [5]. Based on the finger-tapping study created by Rabinowitz et al. (2014) since participants were asked to finger-tapping in a self-paced manner, which led to proposed a study about whether increasing the participants' tapping speed would affect the participants' attention. Therefore, the hypothesis of this proposed study was finger dexterity enhances the attention capacity of older adults.

2 Proposed Study: How Finger Dexterity Affect Older's Attention?

To explore the question that how does finger dexterity affect the attention capacity of older people, we had two groups of participants for the test. First, we randomly divided the participants into two groups, one group received finger training and the other group did not receive finger training. Then, both groups of participants were given the same Digital Span Task, which Reuben and Rosen mentioned that a task of attention and working memory by a computer-generated digit span test [6]. The numbers for each test sequence were generated using a number generator, and each number appeared only once in a sequence. Each test had two attempts, started with a four-digit test, then a five-digit test, and so on, up to seven digits [5]. The participants also had to wear a touchpad equipped with a pressure sensor to perform Finger Tapping. The data from the Finger tapping was recorded on a computer by connecting the pressure sensor to a data acquisition card. After data collection, the data from the finger tapping and digital span task was analyzed to assess the effects of finger dexterity and attention in older adults. After the subjects had memorized the numbers within 30 s, we asked the subjects to repeat the numbers they saw and did the record.

3 Method

3.1 Participants

Before we determined the participants, we tested memory and finger dexterity in 60- to 70-year-olds in care homes in Shanghai, China through finger tapping and the Digital Span Task [5]. In the end, we selected 60 to 70-year-olds with similar finger dexterity and memory who have no medical history which will affect their brain (cognition skills) to be tested in a care home in Shanghai, China. After that, we randomly divided the total participants into two parts. The treatment group (50 seniors) did the finger exercise. Then another 50 seniors which is the control group did not do the finger exercise.

3.2 Stimulation Protocol: Finger Exercise

Fifty randomly selected participants were trained according to the Finger exercise proposed by Li et al. (2021). The finger exercise training consisted of four exercises, (1) finger grasping. One hand grasps the fingers of the other hand in an interactive manner. (2) Finger opening and closing. Both hands open or close simultaneously to make a fist. (3) Finger extension. The five fingers of both hands are extended one after another. (4) Finger clicking [2]. The five fingers are clicked in turn by the other hand interactively. Each of the above movements was repeated 20 times for 3–5 cycles twice a day [2]. In the other part of the participants did not do the finger exercise. After three months, both the group that did the finger exercise and the group that did not do the finger exercise did the number span task.

3.3 Behavioral Outcome Measurement

Rabinowitz et al. (2014) used Digital Span Task by letting participants tap their fingers at their appropriate speed. However, we increased the speed of the finger tapping of one part of the participants and compared it to another part with their self-adapted finger tapping speed. Finger tapping, each participant was asked to tap for 15 s on the pressure pad with the index finger of his/her dominant hand. The tapping was performed according to a fast rhythm and a common rhythm. Finger taps were recorded using a touchpad mounted on a pressure sensor and connected to a data acquisition card [5]. Two groups of participants performed finger tapping for 15 s while remembering the numbers that appear on the computer. After that, participants were asked to recall the numbers they saw on the computer screen.

3.4 Predictions

The left side of the Fig. 1 shows the group who did the exercise (the treatment group) and the right side represents that the group which did not do the exercise (the control group). The blue stick represents the speed of tapping before the three months and the orange stick shows that the tapping speed three months later. The prediction showed that Elderly people who did finger exercise had a faster finger tapping speed. In contrast, the tapping speed of older adults who did not do finger exercises remained almost constant [2].

Figure 2 shows the prediction related to the Seniors' short-term memorization of number series. The two sticks on the left side represent the group who did the finger exercise (the treatment group), and the right sides represent the group which did not do the exercise (the control group). The prediction shows that older adults who did finger exercises to tap faster were able to recall more numbers. However, older adults who were not required to do finger exercises [2] and tapped at a normal speed recalled a similar number of digits as they did three months earlier.

Based on the previous study, Working Memory and Attention, Oberauer found the positive correlations between working memory and people's attention [7] According to the data, older adults who did finger exercises to increase the speed of finger tapping were able to recall more numbers than those who did not do finger exercises and maintained

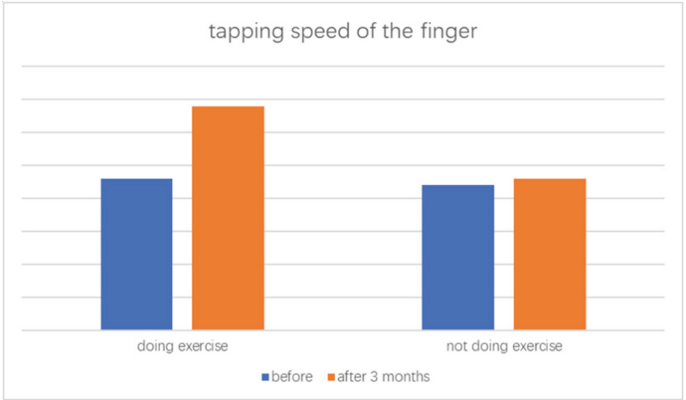


Fig. 1. Tapping Speed Of finger

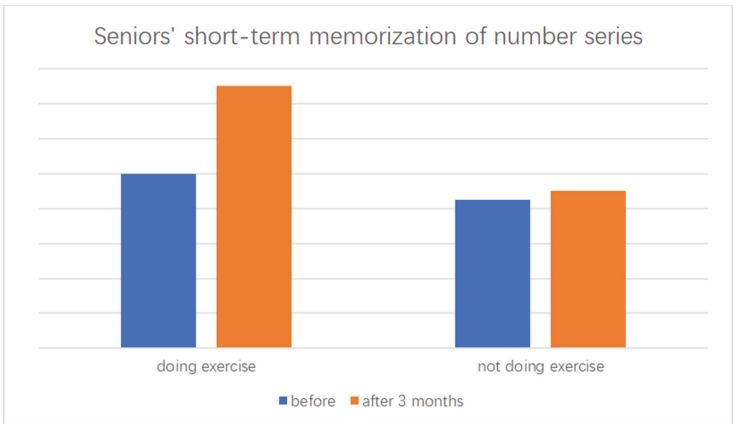


Fig. 2. Seniors' short-term memorization of number series

the same speed of tapping. Therefore, older adults who tapped faster after finger exercise had a higher attention span than those who did not do finger exercise [2].

4 Implications and Further Studies

If the conclusion of the experiment is similar to or close to the prediction. We could come to realize that (1) the finger exercise could improve the tapping speed. The reason for a faster tapping speed may be that the muscles have been strengthened by doing the finger exercise [2]. (2) the finger exercise could let seniors who have a decline in their capacity of attention, have better attention, such as the short-term memorization. With this consequence, we could assume that finger exercise has a correlation between both the finger muscles and at least one side of the brain hemisphere.

Alternatively, there are also several possible outcomes of the experiment. First, if the prediction about the tapping speed is correct but the short-term memorization was not

right. We could come to realize that 1) the exercise does have the effect to improve the tapping speed. Therefore, as a forehead mentioned, maybe the Finger exercise have the effect that will make our muscles which relate to the finger tapping. 2) the finger exercise would not affect the short-term memorization and attention, or because previous study shows that the finger exercise do have the effect on stroke patients, so, the finger exercise may have no effects on the brain hemisphere which related to the sohrt-run memorization and attention [2]. Second, if the prediction of the Short-term memorization is correct but the tapping speed is not correct. We could come to realize that (1) the finger exercise would not affect the tapping speed. (2) the finger exercise could improve the brain's function of short-term memorization and attention, we can come to realize that the finger tapping may be a suggestive action for a quicker memorization, or the ability of the short-term memorization and attention don't relate to the muscle strength of the finger to accelerate the tapping [2]. Third, if the prediction about both the seniors' short-term memorization and attention and the finger tapping's speed are wrong. We can come to realize that (1) the finger exercise won't affect the ability of accelerate the speed of tapping. (2) the finger exercise won't help subjects memorize more in a short time and their attention won't be affect too [2].

For the future study, the predicted results of this study may help explore other components of finger dexterity on cognition in older adults in subsequent studies. The predicted results may play an important role in promoting finger training in daily and clinical care. Moreover, finger exercise may also help young people to prevent cognitive impairment problems that will be encountered in old age [2]. As a result, the finger exercise may play a very important role, and may be able to bring more practical usages. For instance, the finger exercise would help students to memorize more knowledges and increase their language skills by memorizing and understanding more vocabularies. The younger generation could prevent the decline of concentration and short-term memory in old age by doing finger exercises. In addition, older adults could enhance their concentration and short-term memory through finger exercises. Finger exercises that provide the elderly with finger dexterity and result in improved concentration would help in subsequent clinical studies.

5 Conclusion

The study showed that older adults who performed finger exercises had quicker finger taps and better attention spans. Under the same physiological conditions, the results of a three-month finger exercise experiment showed that the older adults who performed the finger exercise had greater finger dexterity because they could tap their fingers faster. The Digital span task also showed that those older adults had better short-term memory and showed more concentration. However, those who did not perform finger exercises had almost the same finger dexterity after three months as they did at the beginning. The Digital Span task showed that their short-term memory and attention were not as good as those who had finger training. In this study, Finger Exercise [2] would help to increase short-term memory and attention in older adults, so this finger exercise will be used in later rehabilitation of cognitive problems in older adults to promote the rehabilitation effect. In addition, finger training could be used in the middle-aged population to prevent short-term memory loss and attention loss in old age.

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