

# Executive function measured by Stroop test and mood for elderly people in a facility for the elderly

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## Abstract

The number of elderly people has been increasing recently, and it is important to keep cognitive function healthy. This study aims to investigate relationships between cognitive function measured by the Stroop test and mood for elders in an institute. Ten elders participated in this study voluntarily. They performed the Stroop task (Stroop interference, reverse Stroop interference, correct number) to measure cognitive function, and completed the POMS (Profile of Mood Scale). The scores of "Tension-Anxiety," "Depression," "Anger," "Fatigue" and "Confusion" were lower than those of the standard, and the "Vigor" score was higher than the standard. The Stroop-interference ratio was higher, the reverse Stroop interference ratio was lower, and the correct response numbers were almost lower than the standard. The Stroop ratio was significantly related with Vigor ( $r=-0.65$ ,  $p<0.05$ ), the reverse Stroop ratio was significantly related with Tension-Anxiety ( $r=-0.63$ ,  $p<0.05$ ), and the correct response number was related with Vigor ( $r=0.59$ ,  $p<0.05$ ). These results showed that the elders of this institute stated to have good moods, and interference of words was high, though color interference was low. Elders with high vigor could inhibit word interference and named colors correctly, and elders with low tension-anxiety could inhibit color interference and named words correctly. Elders with high vigor showed high performance. Promoting vigor may lead much more cognitive health.

## Introduction

Recently the number of elders has been increasing, and the number of elderlies with dementia is also increasing. Since there are many elders who live in institutions, it is important for them to live, keeping a good cognitive function.

Trichard *et al.* [1] showed that cognitive functions of those with clinical depression are lower than healthy people. This suggests relationships between cognitive function and mood. Sugimoto [2] also showed that the performance of the correct response measured by the Stroop of the not-well mental health group was lower than those of the healthy group. This also suggests relationships between cognitive function and mood.

Byunk *et al.* [3] clarified the effects of exercise on cognitive function for healthy people. They used the Stroop test to measure cognitive function, and there are positive relationships between cognitive function and arousal which is thought to be a factor of mood. Since participants were middle age or healthy adults, in Sugimoto [2] or Byunk *et al.* [3], it is no wonder that this relationship between cognitive function and mood is observed for elders. Particularly, cognitive function of elders in an institution may be lower than those of healthy people. Therefore, the present study investigated whether there is a relationship between cognitive function and mood.

In cognitive function, inhibition is one of the most important functions. Inhibition means that people inhibit information in order to focus on the other information, and inhibition function decreased when aging [4]. The Stroop test is one of the famous tests to measure inhibition function. Then this study used the Stroop test to measure cognitive function, and examined relationships between cognitive function and mood.

## Method

### Participants

Inclusion criteria were that a person could communicate with others, and that a person could express their intention about participating. Exclusion criteria were that elders had serious mental illness or dementia. Participants in this study were 10 elders (female) who lived in a facility for elders. They needed some kind of help from nursing care staff. The mean age was 73 years.

### Scales

**Cognitive function:** We used the Stroop test II [5,6]. It can measure the Stroop interference ratio (inhibition of words to respond to color), the reverse Stroop interference ratio (inhibition of color to respond to words), and correct response number.

**Mood:** We used POMS (Profile of Mood Scale) which was developed by McNair, Lorr, and Droppleman [7] and was translated into a Japanese version [8]. It consists of six factors: Tension-Anxiety, Depression, Anger, Vigor, Fatigue, and Confusion.

### Procedure

The researcher visited the facility after getting permission from

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the ethical committee. The staff in the institution asked elders for this study who cleared inclusion criteria and confirmed elder's intention whether they would participate or not in this study. The researcher met an elderly individually. The elderly received both the Stroop test and the POMS. The total duration time was about 30 minutes.

### Ethical consideration

This study was approved from the ethical committee in authors' college and from the facility for elders.

### Results

Table 1 shows the basic scores of elders and the scores of sub-category of POMS. Most of the scores were lower than the standard [8]. It shows that they are in a good mood. Moreover, they had high vigor.

Table 2 shows that the Stroop and the reverse Stroop ratio, and correct number. The scores of the Stroop were higher than the standard [5,6], but the reverse Stroop was lower. The correct response number of elderlies in the present study was lower than the standard.

Table 3 shows the correlation coefficients between the Stroop test and mood. The Stroop interference score is negatively related with Vigor ( $r=-0.65$ ,  $p<0.05$ ), the reverse Stroop interference score is negatively related with Tension-Anxiety ( $r=0.63$ ,  $p<0.05$ ). Vigor is also significantly correlated with the correct response number ( $r=0.59$ ,  $p<0.05$ ).

### Discussion

About Mood, the scores of the present study were lower than those of the standard, except Vigor. This means that there was no problem about mood and that they spend daily life peaceful in a facility. However, as for the correct response number, their correct response number of Task 1, Task 2, and Task 3 were lower than the

standard. That is, though the moods of the elders in the facility were calm, their cognitive function might be lower than the elders who live in community dwellings. Some kind of intervention to keep cognitive function might be needed. It is a little similar that the correct response number of workers recovering from clinical depression was lower than healthy people, although they did not feel fatigue subjectively [2].

As for the Stroop test (Table 2), the score of the Stroop interference ratio was higher than those of the standard (70-86 years), but the score of the reverse Stroop interference was lower. It suggests that elders in the present study cannot inhibit word inference when they need to focus on color, and they can inhibit color inference when they need to focus on words. The power of words may be strong. Park *et al.* [9] showed that the meaning memory as language ability is hard to influence by aging and is thought to increase; therefore, word interference may be strong. Moreover, their weak inhibition of color may be related with decreased sensitivity of retinal illuminance and contrast sensitivity [10]. In clinical situations, it may be useful for nursing care staffs to propose exercises including color or contrives including color in a facility to keep elder's color ability.

About correlation, the significant relationship between the Stroop interference ratio and Vigor of POMS suggests that vigor can inhibit words well and treat color information. Since word information process is a daily habit, vigor will be needed to process color information. This result supports that high arousal improves response time in the Stroop test [3].

The significant relationship between the reverse Stroop interference ratio and tension-anxiety suggests that low tension-anxiety can inhibit color information and treat word information. Elders with low tension-anxiety can read books or newspapers in daily life in the institution, not interfered by color information.

Lastly, the positive relationship between the correct response number and Vigor suggests that cognitive function needs much more vigor. It supports that more energy will be needed in executive function.

As a limitation, the number of participants was small and we could not generalize this fact. In the future, much more participants will be needed. Moreover, we need to develop intervention to promote cognitive function in the future.

### References

- Trichard C, Martinot JL, Alagille, M, Masure MC, Hardy P, et al. (1995) Time course of prefrontal lobe dysfunction in severely depressed in-patients: a longitudinal neuropsychological study. *Psychol Med* 25: 79-85. [Crossref]
- Sugimoto Y (2014) Factors affecting reinstatement of employees who have taken medical leave due to mental health disorders: from the perspective of the new Stroop Test and Fatigue. *Job Stress Research* 21: 259-269.
- Byun K, Hyodo K, Suwabe K, Ochi G, Sakairi Y, et al. (2014) Positive effect of acute mild exercise on executive function via arousal-related prefrontal activations: an fNIRS study. *Neuroimage* 98: 336-345. [Crossref]
- Kumada T (2015) Elders' Executive function. *Japan Journal of Geriatric* 26: 429-435.
- Hakoda Y, Sasaki M (1990) Group version of the stroop and reverse-stroop test-The effect of reaction mode, order, and practice. *Japanese Journal of Educational Psychology* 39: 231-239.
- Matsumoto A, Yuji H, Watanabe M (2012) Life-span development of Stroop and reverse-Stroop interference measured using matching responses. *Shinrigaku Kenkyu* 83: 33-346. [Crossref]
- McNair DM, Lorr M, Droppleman LF (1992) Profile of Mood States. San Diego, Educational and Industrial Testing Service.
- Yokoyama K (Ed.) (2010) POMS Brief version, guide book and case explanation, Kaneko Syobo, Tokyo.

**Table 1.** The basic score of the POMS.

	Elders	Standard
Tension-Anxiety	2.3 ± 2.6	6.9 ± 4.0
Depression	1.5 ± 1.4	3.8 ± 3.7
Anger	0.8 ± 1.4	4.9 ± 3.8
Vigor	11.0 ± 5.6	9.5 ± 4.2
Fatigue	2.0 ± 2.4	6.7 ± 4.7
Confusion	4.3 ± 2.7	5.6 ± 3.1

**Table 2.** The Stroop - reverse Stroop interference ratio and correct response number.

	Elders	Standard (70-86years)
<b>Stroop-interference</b>	24.3 ± 29.1	21.1 ± 32.7
<b>Reverse-interference</b>	4.05 ± 13.5	13.3 ± 19.9
<b>Correct response number</b>		
<b>Task 1</b>	29.6 ± 11.1	37.4 ± 12.5
<b>Task 2</b>	28.1 ± 9.5	31.5 ± 10.5
<b>Task 3</b>	21.9 ± 4.9	24.2 ± 7.6
<b>Task 4</b>	17.1 ± 7.0	18.7 ± 8.6

**Table 3.** The correlation coefficients between the Stroop task and mood.

	Stroop	Reverse Stroop	Correct response number
Tension-Anxiety	-0.32	-0.63*	0.18
Depression	-0.17	0.02	0.28
Anger	-0.47	-0.07	0.36
Vigor	-0.65*	0.13	0.59*
Fatigue	-0.09	-0.28	0.18
Confusion	-0.12	-0.5	0.16

9. Park DC, Lautenschlager G, Hedden T, Davidson NS, Smith AD, et al. (2002) Models of visuospatial and verbal memory across the adult life span. *Psychol Aging* 17: 299-320. [[Crossref](#)]
10. Haegerstrom-Portnoy G, Schneck ME, Brabyn JA (1999) Seeing into old age: vision function beyond acuity. *Optom Vis Sci* 76: 141-158. [[Crossref](#)]

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