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Research Article

Visual and auditory sentence processing in olderadults: Effects of predictability on recognition ability

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ABSTRACT

Subjective cognitive impairment (SCI) only subjectively complains of memory problems, but the prerequisite is that neuropsychological tests must be normal. However, previous studies have often reported decreased connectivity in SCI's fronto-pariental cortex and medial frontal cortex, and decreased performance compared to normal controls in naming, discourse, and memory tasks. Recently, in-depth consideration is being given to their processing ability in various cognitive-language tasks. In this study, we focused on recognition ability, which is important in memory retrieval, and examined how the sentence recognition ability of the normal group (N=16) and SCI (N=15) differed depending on sentence predictabilty and stimulus type. As a result, both groups showed poorer performance in auditory stimuli than visual stimuli, and SCI performance was found to be further reduced in low predictability (LP) sentences that require more attention. The slow appearance of semantic priming for the target word indicates a decrease in real-time processing ability to utilize information, which is affected by attention and memory. Although patients subjectively complain of memory problems, objectively identifying the attention concentration and memory processing of SCI, which is already impaired, can be considered to have valuable clinical value.

Keywords: Recognition, Predictability, Processing, Subject Cognitive Impairment.

INTRODUCTION

Deterioration of language function due to aging may result in decreased language comprehension or expression, which has a negative impact in communication situations [1]. Because communication progresses quickly, efficient language processing is required to predict the likely next word [2],[3]. This anticipatory behavior appears to operate broadly across language domains and is an essential component of human language processing [4].

Many previous studies agreed with the claim that real-time processing of sentences declines due to aging, and in particular, Cohen (1979) [5] mentioned that there is an aging effect in which reasoning declines in older people. During the aging process, memory connections weaken and activation of target information decreases, making it difficult to immediately recall information. Additionally, functional decline in various cognitive factors, including attention, memory, and reasoning, also causes difficulties in language processing [6]. As memory problems that occur in daily life become more frequent, the number of older adults with SCI who 'subjectively' complain of memory problems is increasing. From a neuropathological perspective, neurobiological changes are at the root of age-related cognitive decline. Age-related cognitive decline can occur due to a decrease in the function of the prefrontal cortex and a decrease in neurotransmitters that regulate the prefrontal cortex. SCI already shows decreased functional connectivity of the fronto-pariental cortex and visual attention and semantic memory linked to the medial frontal cortex [7],[8]. This metabolic

slowdown may cause difficulties in language processing.
According to previous studies, older adults with SCI also show low performance in areas such as tip-of-the-tongue phenomenon, decline in discourse ability, and semantic knowledge due to decline in cognitive and language abilities. However, not much research has been conducted on recognition, one of the biggest characteristics of SCI, 'memory', and most of the word recognition studies have been conducted on the general elderly.
This study attempted to conduct a task by focusing on SCI complaining of memory decline, and focused on recognition ability, which is important in memory retrieval, among memory problems. In addition, we focused on the sentence level in daily life communication rather than word recognition and examined differences depending on the stimulus type. Previous studies have shown that visual stimulation has a greater impact on memory recall, and that visual memory increases compared to auditory memory as people age [9]. Accordingly, we attempted to examine whether there were differences in sentence recognition ability depending on the stimulus type (visual, auditory). Examining the effects of predictability on recognition ability in visual and auditory sentence processing can be well used as differential information for cognitive decline in the elderly.

METHODS

A. Subjects

The subjects were 16 normal elderly people over 65 years old and 15 SCI people living in G-si, Gyeongbuk, South Korea. There were no neurological or mental diseases and there were no abnormalities in vision or hearing. The criteria for selectingcandidates are as follows.

1) Normal Elderly (NE): Cognitive function within the normal range according to the Korean-Mini Mental State Examination (K-MMSE, Kang, 2006); No depression on the Geriatric Depression Scale Short Form Korea Version (GDSSF-K, Ki, 1996)[10]; normal in the Korean version of Instrumental Activities of Daily Living (K-IADL, Kang et al., 2002)[11]; Those who fall within the normal norms on the Seoul Verbal Learning Test (SVLT) included in the Seoul Neuropsychological Screening Battery (SNSB, Kang & Nah, 2002)[12].
2) Subject Cognitive Impairment (SCI): All the same as the NE selection criteria, but as an additional test, a subjective memory impairment checklist is performed to select subjects who complain of subjective memory complaints. The criteria are

(1) no structural/functional abnormalities of the brain or psychiatric disease; (2) persistent complaints of memory impairment for more than 6 months; (3) think that current memory is worse than 5 to 10 years ago; (4) Can give vivid examples of memory disorders that occur in daily life; (5) Memory problems occur at least once a week.

As a result of the homogeneity test for the age, years of education, K-MMSE, and GDSSF-K scores of the two groups, there was no significant difference between the two groups ($p>.05$). The demographic information of the subjects is presented in (Table 1).

Table 1. Demographic information of study subjects

	NE (N=16)	SCI (N=15)	*t*	*p*
age (years)	72.00 (±6.23)	75.13 (±5.05)	-1.532	.136
years of education	11.13 (±4.32)	8.73 (±2.55)	1.892	.070
K-MMSE (points)	27.81 (±1.11)	27.20 (±1.01)	1.602	.120
GDSSF-K (points)	2.88 (±2.00)	3.27 (±2.09)	-0.532	.599

A. Experimental tasks

1) Experimental task creation and preliminary test

The recognition task consisted of a total of 40 questions, including 20 sentences with high predictability and 20 sentenceswith low predictability.
HP : 'I exercise every day to be healthy.'"What do I do every day?"
LP : 'The ladies shared bananas in front of the house.'"What did the ladies share?"
Twenty normal adults in their 20s to 50s were asked to rate the predictability of each of a total of 40 questions on a 5-point scale (1 point: very low predictability - 5 points: very high predictability). Based on the median value, 10 HP items and 10 LP items were selected, of which 50% were visually presented and the remaining 50% were classified as auditory presentations.
In order to equalize the difficulty level of the 20 selected questions, the difficulty level was verified on 10 normal elderly people over 65 years of age. As a result, all 20 questions were found to have uniform difficulty levels.

2) Field test

In the visual task, both direction and target word questions consisted of only letters and were presented visually. The order of assignment presentation is as follows. The first screen displays a '++' sign for 1000 ms

to focus the subject's attention. In the next screen, the instructions are presented for 3000 ms, and then the question of the target word is presented for 10000 ms.
The procedure for the auditory task is the same as the visual task, but the difference is that both direction and target word questions are presented auditorily using only audio without picture or letter stimulation.

3) Scoring

(1) Correct response score

The total correct response score of the experimental subject was calculated, including 10 questions each according to sentence prediction difficulty (HP, LP) and 10 questions each according to the stimulus type (auditory, visual). The score is 1 point per question, for a total of 20 points including both HP (visual modality: 5 scores, auditory modality: 5 scores) and LP (visual modality: 5 scores, auditory modality: 5 scores).

(2) Measurement of response time

(3) For this task, the Praat program was used to measure the time in ms between the last point of the task stimulus and the start of the subject's speech. Following the speed-accuracy trade-off effect of Townsend & Ashby (1983) [13], erroneous responses were converted to inverse efficiency scores (IES) and used to calculate reaction speed. The IES calculation method is as shownin (Figure 1).

$$IES = \frac{RT}{1-PE} = \frac{RT}{PC}$$

Fig 1. Calculation formula for inverse efficiency scores

4) Statistical analysis

All data in this study were analyzed using SPSS (Statistics Package for the Social Science, version 28.0). Two-way ANOVAwas conducted to compare the difference in the total correct response score and response time of the recognition task accordingto the sentence predictabilty and stimulus type between the two groups.

RESULTS

The difference in correct response of the recognition task according to the sentence predictabilty between the NE and SCI groups showed significant differences depending on the group($F(1,58)=11.402$, $p<.01$) and the sentence *sentence* predictabilty($F(1,58)=33.808$, $p<.001$)(see fig 2).

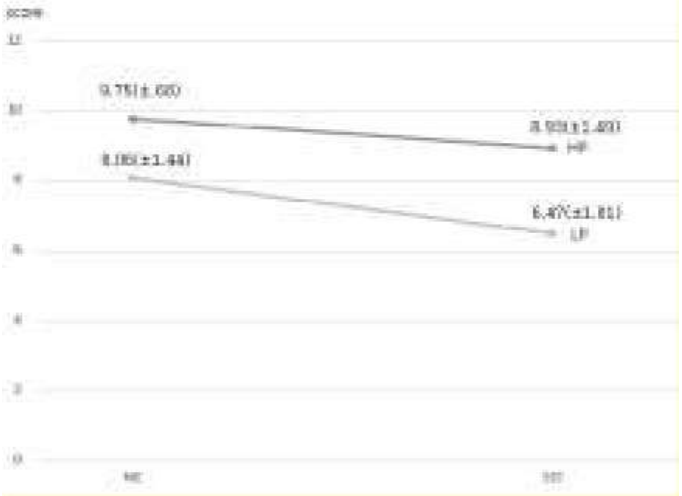

Fig 2. Comparison of correct response in the recognition task according to the sentence predictabilty between the two groups

As a result of comparing the response time in the recognition task according to the sentence predictabilty between the NE and SCI groups, significant differences were found depending on the group($F(1,58)=5006.978$, $p<.01$) and sentence predictability($F(1,58)=4010.023$, $p<.05$)(see fig 3).

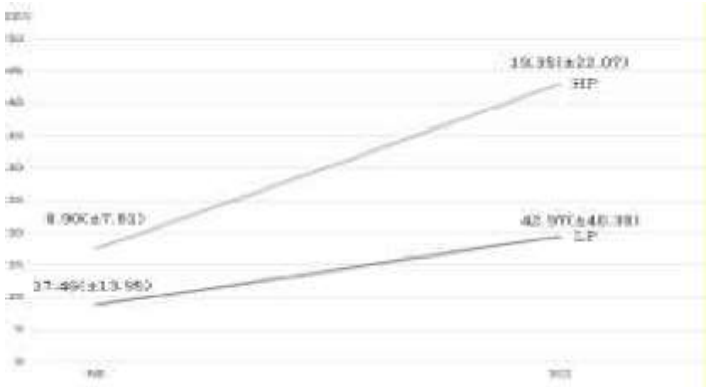

Fig 3. Comparison of response time in the recognition task according to the sentence predictabilty between the two groups

As a result of comparing the difference in correct response of the recognition task between NE and SCI according to stimulus type, significant differences were found depending on the group($F(1,58)=7.720$, $p<.01$) and stimulus type($F(1,58)=20.722$, $p<.001$)(see Table 1).

Table 1. Comparison of correct response in the recognition task according to stimulus modality between the two groups

	NE (n=16)	SCI (n=15)
visual modality	9.50(±0.97)	9.00(±1.41)
auditory modality	8.25(±1.24)	6.40(±2.61)

As a result of comparing the difference in response time in the recognition task between NE and SCI according to stimulustype, there was only a main effect of group($F(1,58)=5006.978$, $p<.05$)(see fig 4).

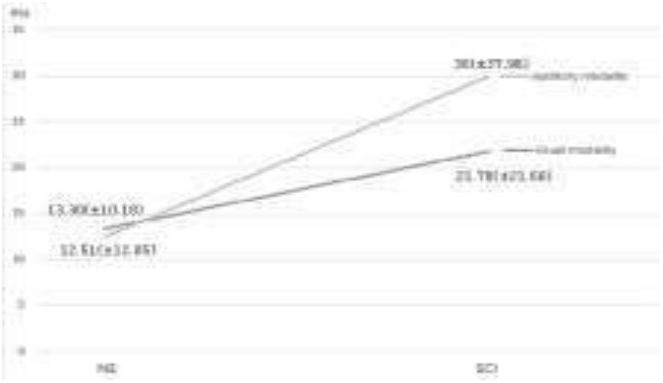

Fig 4. Comparison of response time in the recognition task according to the stimulus type between the two groups

DISCUSSIONS

As a result of comparing the differences in correct response and response time in the recognition task according to sentence predictability between the two groups, the SCI showed significantly poorer performance than the NE. This can be interpreted to mean that in the SCI complaining of subjective memory complaints, semantic priming for target words already appears slowly and real-time processing ability to utilize information is reduced. Previous studies have mentioned that the function of the medial frontal lobe, which is involved in cognitive processing, is already reduced in SCI, and the results of this study alsosupport these previous studies [3],[4].

Sentence predictability also caused differences in correct response and response time in the recognition task, which was consistent with previous research results [14],[15] showing that recognition of target words occurred more actively when semantically related priming words were presented.

The performance of the recognition task according to the stimulus type in the SCI was significantly lower than that in the NE, and both groups showed significantly lower performance on the auditory stimulus items than on the visual stimulus items. Compared to auditory modality, visual modality have the advantage of increasing interest in the task by increasing attention and storing abstract information in the mind in a concrete and planned manner, making retrieval easier [16]. To interpret the meaning of the results of this

study, it can be interpreted that presenting in a visual modality rather than an auditory modality has a greater effect on context recognition.

CONCLUSSION

Slow semantic priming for target words indicates a decline in real-time processing ability to utilize information, which is affected by attention and memory. Even at the stage when a people shows normal performance on the Mini-Mental State Test or formal memory test but subjectively complains of memory complaints, attention and memory may already be subtly reduced, which can reduce the ability to utilize information in semantic processing. The results of this study demonstrated that the SCI had difficulties in inferring and predicting through cue, resulting in weaker memory connections and lower activation of target information, resulting in a decrease in recognition ability compared to the normal elderly. It is believed that the use of the recognition task can be an indicator for early detection of cognitive decline, and will be used as useful data when evaluating and selecting rehabilitation goals for neurological communication disorders in the elderly.

REFERENCES

1. J. Kim and H. Kim, Communicative Ability in Normal Aging: A Review, Journal of Communication Sciences & Disorders, Dec 14(4),pp.495-513, 2009.
2. M. Yoshida, M. W. Dickey and P. Sturt, Predictive processing of syntactic structure: Sluicing and ellipsis in real-time sentence processing. Language and Cognitive Processes, Apr 28(3), pp. 272-302, 2013.
3. S. C. Hayes, Acceptance and Commitment Therapy, Relational Frame Theory, and the Third Wave of Behavioral and Cognitive Therapies – Republished Article, Behavior Therapy, November 47(6), pp. 869-885, 2016.
4. M. Arai and F. Keller, The use of verb-specific information for prediction in sentence processing, Language and Cognitive Processes,28(4), pp. 525-560, 2013.
5. G. Cohen, Language comprehension in old age, Cognitive psychology, 11, pp.412-429, 1979.M. A. Yoo, S. H. Oh, J. S. Kyong and J. E. Sung, Age-related Differences in the Effects of Working Memory Capacity and Cognitive Load on Word Recognition: An Eye Tracking Study, Journal of Communication Sciences & Disorders, June 26(2), pp. 392 ~ 412, 2021.
6. C. F. Eliassen, I. Reinvang, P. Selnes, R. Grambaite, T. Fladby and E. Hessen, Biomarkers in subtypes of mild cognitive impairment and subjective cognitive decline. Brain and behavior, Sep 7(9), pn/a-N.PAG, 7p, 2017.
7. M. J. Buckley, D. Gaffan and E. A. Murray, Functional double dissociation between two inferior temporal cortical areas: Perirhinal cortex versus middle temporal gyrus. Journal of Neurophysiology, Feb 77(2), pp.587-598, 1997.
8. N. Y. Lee, S. H. Ahn and J. Y. Shin, Comparison of Short-Term Memory Ability According to the Information Presentation Method for the elderly: Visual and Auditory Stimulation, Korea journal of geriatric occupational therapy, June 2(1), pp. 17-25, 2020.
9. B. S. Ki, A Preliminary Study for the Standardization of Geriatric Depression Scale Short Form-Korea Version, Journal of KoreanNeuropsychiatric Association, 3, pp. 298 - 307, 1996.
10. S. J. Kang, S. H. Choi, B. H. Lee, J. C. Kwon, D. L. Na and S. H. Han, The Reliability and Validity of the Korean Instrumental Activities of Daily Living (K-IADL), Journal of Korean Neurological Association, 20(1), pp. 8-14, 2002.
11. Y. W. Kang and D. L. Na, Seoul neuropsychological screening battery(SNSB) professional manual. Incheon, Korea: Human BrainResearch & Consulting, 2003.
12. J. T. Townsend, and F. G. Ashby, Stochastic modeling of elementary psychological processes, CUP Archive, 1983.
13. K. Nam, E. Lee, H. Jeon, S. Lee and Y. Kim, The Effects of Semantic and Syntactic Information from the Preceding Eojeol on Word Recognition in Korean: A Priming Study, Journal of Korean language and literature, 9, pp. 273-312, 2018.
14. M. Perea and A. Gotor, Associative and semantic priming effects occur at very short stimulus-onset asynchronies in lexical decision andnaming. Cognition, 62(2), pp. 223-240, 1997.
15. P. J. Holcomb and H. J. Neville, Auditory and visual semantic priming in lexical decision: A comparison using event-related brain potentials. Language and cognitive processes, 5(4), pp. 281-312, 1990.