ORIGINAL ARTICLE

The relevance of cognitive dysfunction and comprehension of abstract words

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Abstract
In healthy subjects, the comprehension process is different between abstract words and concrete words. Previous studies reported that the understanding speed is faster and more accurate for concrete words than abstract words; however, this difference is increased in subjects who have language dysfunction due to brain damage. In this report, we focused on abstract words, and investigated how the ability to comprehend them may be used in the evaluation of language acquisition and adult cognitive function. In the literature, studies on the understanding and expression of abstract words rarely included patients with dementia. In this study, we examined the understanding and expression of abstract words in three patients with dementia using the Mini-Mental State Examination (MMSE), the Abstract Word Understanding Test (SCTAW), and a free conversation analysis. The SCTAW results showed that all subjects had scores below the average of the same age group. Moreover, the most common false-reaction pattern was observed, and it was found to be associated with "semantic-related" stimuli, with the same type of error most frequently occurring in healthy subjects. In addition, the results of the conversation analysis showed that MMSE scores and the number of abstract words expressed by the patients tended to be correlated. Therefore, the results suggested that cognitive function was correlated with the number of abstract words expressed.

Key words: *Impairment of language, cognitive dysfunction, abstract words, dementia*

INTRODUCTION

Which word would be easier to imagine when you hear the words "apple" or "hope"? There is a difference between these two words, as they express concrete and abstract concepts, respectively. Previous studies showed a difference between the process and speed of comprehension of these kinds of words. In this report, we focused on the process of understanding abstract words, and reported the results of a conversation study among elderly subjects with dementia.

UNDERSTANDING AND EVALUATION OF ABSTRACT WORDS

Definition

Abstract words are almost synonymous with abstract nouns; according to the 5th edition of Kojien, abstract nouns represent abstract concepts, such as "exercise," "health," and "love." An abstract concept may belong to a concrete item, but it can be considered separately, and it can be categorized into the following four kinds of concepts (Shinmura, 1998):

a) An attribute separated from the subject (e.g., human nature).
b) Concepts that cannot be directly perceived (e.g., justice).
c) Characteristics describing a partial aspect of objects (e.g., blue).
d) Concepts enclosed in our consciousness or imagination (e.g., duty, Pegasus).

The above is a list of the meanings of abstract nouns, but these are not lexical or linguistic terms; thus, interpretation is necessary. In this report, we define abstract words in broader terms than abstract nouns, thus including nouns in the classification of formal elements and adjectives. For adjectives, we include both "descriptive usage," which expresses the framework of a concept, and "limited usage," which narrows the set of nouns. For example, the adjective "beautiful" can be used with the following two meanings: "This flower is beautiful" (descriptive usage) and "A beautiful flower is blooming" (limited usage) (Machida, 2004; Saito, 2013).

In daily linguistic communication, we are not aware of the differences between abstract and concrete

words. However, it has been reported that the neural processing mechanisms of these two types of words are different. Behavioral experiments in healthy subjects showed that concrete words, which are easier to imagine, are processed faster and more accurately than abstract words (Haruhara, 2002). Another study showed that the difference is even greater in patients with language dysfunction due to structural damage to the brain, and it is common for aphasia patients to make more errors processing abstract words than concrete words in the language task used in the study (Jefferies, 2006).

Language acquisition and abstract words

There have been few reports on abstract words in the context of language development. Language comprehension abilities develop before expression abilities in 10–15-month old children. After they acquire their first 50 words, they rapidly expand their vocabulary. This process is known as "vocabulary explosion," and it often begins after one and a half years of age. It has been reported that among the 50 early comprehension words, the highest proportion (32%) is composed of concrete nouns, while abstract words, describing situations and nature, are present in the lowest proportion (8%) (Iwadate, 2017). Nagashima et al. (2000) conducted a developmental trial consultation for infants as a follow-up observation for children who exhibited a speech delay at their 18-month medical checkup. They found that the acquisition of abstract words (such as concepts of numbers, colors, and spatial relationships) is a critical matter. The abstract words most commonly learned between 24 and 30 months of age are concepts of numbers, colors, space, and time; visually understandable concepts,; and sensible abstract concepts. On the other hand, the words that less than 60% of children between 34 and 35 months of age have learned are concepts related to invisible events or mental states (e.g., feelings, events, and reasons) and concepts related to positions and directions at high levels of abstraction. These words were difficult to judge visually and were inferred by relative relationships. The study showed that whether a word is visually understandable is a critical factor for acquisition of the word during language development.

Abstract words in cognitive function evaluation

Abstract words are also used as indicators for the evaluation of adult independence, brain localized functions, and language disorders. The following is an overview of some evaluation methods:

1) Functional Independence Measure (FIM): the FIM is widely used in Japan and worldwide as an evaluation method for daily activity abilities. The FIM includes a question regarding "communication" as a cognitive item, evaluating the ability to understand and express abstract concepts, for example, when listening to a topic on TV, understanding a joke, or following a conversation with other people (Osaka, 1996). Markers for the understanding and expression of abstract words in the FIM include the abstract words themselves, as well as grammatical expressions and discourse, including syntax and pragmatics, which refers to a broader range of situational understanding and expression.
2) Frontal Assessment Battery (FAB): the FAB test was published in 2000 (Dubois, 2000) and is currently used as a frontal lobe function test (Sato, 2012). The FAB includes a question about "Understanding Similarity (Conceptualization Ability)," which asks the hypernyms at the word level of the semantic structure (e.g., for words like "bananas" and "oranges," the correct answer is "fruits"). The word "fruit" is the abstract word, a "concept that cannot be directly perceived."
3) The standardized comprehension test of abstract words (SCTAW): the SCTAW was developed to detect relatively mild verbal semantic comprehension disorders for adults and children (Haruhara, 2018). Since most of the standardized language tests use concrete words, the SCTAW overcomes the difficulty in detecting mild language disorders by using abstract words. This test defines an abstract word as "a word that is not an obvious concrete word and represents a concept of something or a property that cannot be directly perceived." The target words are all composed of two Japanese kanji characters to control for the difficulties and similarities. The correct answer is presented as a drawing and grouped with five distractor choices: two words sonically similar to the target word (e.g. "Kofuku," happiness; sound-related stimulus: "Koufun / Yofuku"); two semantically similar words (semantic-related stimulus: "easing / playing with a baby"); and one unrelated word (unrelated stimulus: "kantoku"). The individuals choose one of the six drawings expressing the words. In addition to the right choice, it is possible to analyze the false reaction patterns from the wrong answers. In the test procedure, an examiner reads the target word aloud, asks the subjects

to repeat it, and select the picture that best represents the meaning of the target word (for auditory understanding). The time limit is 30 sec after the word is heard. Visual comprehension can also be tested. After seeing a Kanji word card and reading it aloud, the individuals select one of the six drawings (see Figure 1).

Abstract language comprehension and functional localization in the brain

Previous studies on abstract words have reported that several parts of the brain are involved in the comprehension and expression of abstract words (Ciutacu, 2017; Vigliocco, 2017). In an experiment using repeated transcranial magnetic stimulation (rTMS) in healthy subjects, when the activity of the anterior middle temporal gyrus was suppressed, the scores related to the understanding of abstract words decreased. On the other hand, the scores for concrete words was not affected. In addition, a greater decrease in the score was observed with the suppression of the left hemisphere compared to that with the suppression of the right hemisphere. The anterior part of the bilateral middle temporal gyrus, especially on the left side, is thus involved in abstract language comprehension (Ciutacu, 2017). Furthermore, experiments using functional magnetic resonance imaging (fMRI) revealed that, interestingly, the rostral part of the anterior cingulate cortex, which processes emotions, is activated during the process of understanding abstract words (Vigliocco, 2017). These results suggest that abstract words elicit more emotions than concrete words. These results could also be applied to language acquisition, indicating the likely involvement of abstract words in emotional development. Jefferies et al. (2009) showed in a review of 12 fMRI studies that the anterior temporal lobe could be important in the understanding of abstract words; however, the specific functional localization of abstract word comprehension is still not completely understood.

ESTIMATING ABSTRACT WORD COMPREHENSION FROM CONVERSATION ANALYSIS

The symptoms of dementia often include speech disorders that interfere with communication with others. However, there are few detailed qualitative

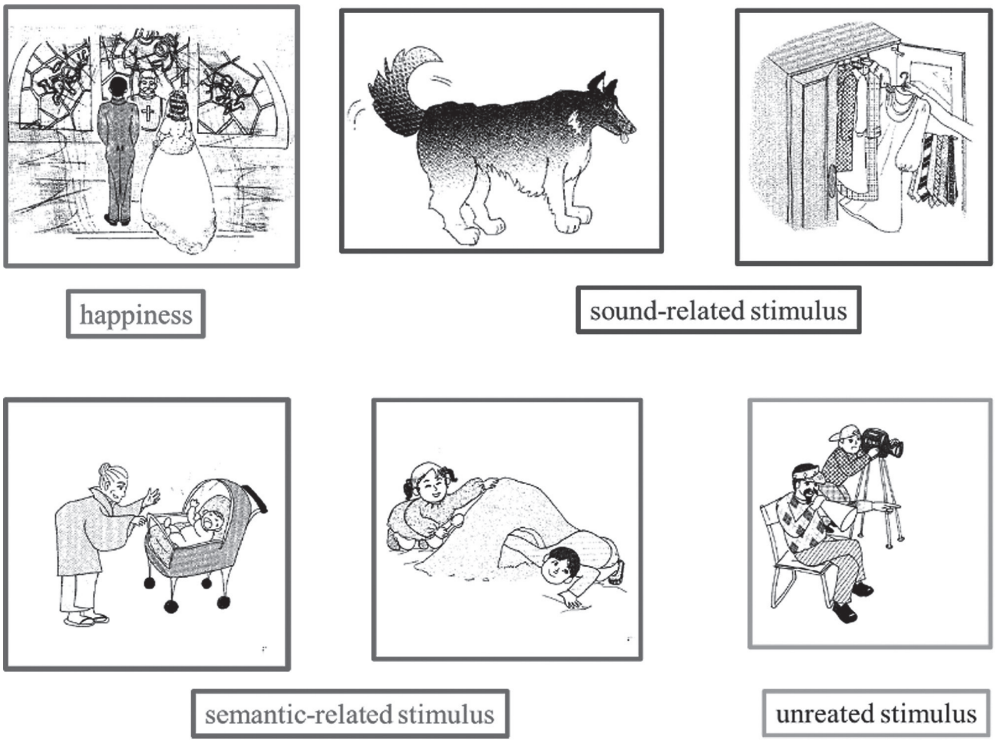

Figure 1. Example from the abstract word comprehension test. The correct answer to the question is “happiness” in the red frame. Any other answer is incorrect and is classified into each incorrect reaction pattern. Blue frame-”sound-related stimulus” incorrect answer response pattern; green frame-”semantic related stimulus” wrong answer reaction pattern; Gray frame- “unrelated stimulus” wrong answer reaction pattern. (Haruhara, 2002)

studies on conversations in dementia cases. Therefore, in this study, we focused on abstract words, analyzing both understanding and expression.

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Methods

The subjects were four elderly women (average age 76.25±3.10 years) who were admitted to a nursing home and were diagnosed with dementia. The following examinations were conducted in a private room: (1) Mini-Mental State Examination (MMSE), (2) SCTAW, and (3) free conversation between one subject and one university student (see Figure 2). For the free conversation, the questions were decided in advance, and a semi-structured interview was used. The questions included one abstract word each, and the conversation time was limited to 5 min. All conversations were recorded and transcribed. Abstract and concrete words were extracted from the transcriptions. The abstract words included in the questions that appeared more than once were not considered for further analysis.

Results and Discussions

The results of the MMSE, SCTAW, and free conversation tests are shown in Tables 1, 2, and 3, respectively. In the MMSE, subject B scored at the cutoff value (23/30 points) and subjects A, C, and D had lower scores.

In the SCTAW test, subject C could not perform the test because of difficulties in understanding the instructions. Subjects A, B, and D each had a lower number of correct answers (28.0, SD 3.4) compared to the average for 70- to 80-year-old subjects. Subject B who had the highest score on the MMSE (23/30 points) had the lowest number of correct answers on the SCTAW (10/32 points). The false response pattern was most frequently “semantically related” in all subjects. In the SCTAW preliminary survey, which aimed to create a standardized norm in healthy subjects, the number of false reactions classified as “semantic-related stimuli” was the highest in the auditory presentation task in all age groups. The proportion of the false reactions of “semantic-related stimuli” in the younger group (20s, and 30s) was 71.7% and was 67% in the elderly group (70s). The results of the false reactions in our study follow the same pattern as the preliminary survey, with the highest percentage of errors selected from the semantic-related stimuli. Therefore, the errors were not due to a complete lack of comprehension.

In free conversation, the number of abstract words expressed was lower than that of concrete words in all subjects. In addition, the MMSE scores and the number of abstract words expressed were proportional, with a higher MMSE score being associated with a higher number of abstract words expressed in the conversation. The results suggest that when a higher cognitive function is maintained, words that are more abstract can be expressed.

Figure 2. Segment shot of a free conversation

Table 1. Scores from the Mini Mental State Examination

Subject	Score
A	18
B	23
C	11
D	19

Table 2. Results of the standardized comprehension test of abstract words

		False response pattern			
Subjects	**Score/Total**	**Semantic-related**	**Sound-related**	**Unrelated**	**No response**
A	19/32	7	0	1	5
B	10/32	11	7	3	1
D	19/32	9	3	0	1

Table 3. The number of Abstract/Concrete words expressed in a free conversation

Subject	**Abstract words**	**Concrete words**	Total
A	15	20	35
B	16	21	37
C	8	17	25
D	10	26	36

CONCLUSIONS

The current results showed a tendency for different neural processing in the understanding and expression of abstract and concrete words, with language dysfunction affecting abstract words in particular. Currently, research on abstract words has progressed due to the challenges of semantic dementia. It is necessary to evaluate the language function from the viewpoint of semantics as well as the classification of morphemes (parts of speech). We hope that the results of our study will be useful for speech treatment in children and adults in the future.

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