# Validity and reliability of the Thai Adaptation of Naming Test-Revised (TANT-Revised)

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## ARTICLE INFO

## ABSTRACT

**Background:** The Thai Adaptation of Naming Test (TANT) is useful for assessing naming ability among Thais with naming deficits. However, the TANT was developed in 2004, meaning some words have become less common. Consequently, the TANT was revised for modernity and suitability for the current Thai cultural context and to measure the psychological properties.

**Objectives:** To assess the validity and reliability of the Thai Adaptation of Naming Test-Revised (TANT-Revised).

**Materials and methods:** The TANT was revised by adjusting certain items for suitability to the current Thai cultural context, consisting of 2 parts: Pictures of words and semantic cues. Subsequently, the TANT-Revised was assessed for content validity index (CVI), content validity for the item (I-CVI), and content validity Index for scale (S-CVI) test by five expert speech-language pathologists (SLPs). Afterward, the TANT-Revised was examined for test-retest reliability by intraclass correlation coefficient (ICC) in an aphasia group and a normal group, with 13 people per group.

**Results:** The results of testing for the validity of TANT-Revised by expert SLPs revealed that the validity for pictures (CVI = 0.96, S-CVI = 0.99, and I-CVI = 1) and semantic cues (CVI = 0.95, S-CVI = 0.99, and I-CVI = 1) have high reliability in the normal group at 0.79 and the aphasia group at 0.96.

**Conclusion:** This study assessed the psychological properties of the TANT-Revised instrument used to test naming ability. The validity of the revision test was high, and the TANT-Revised was deemed acceptable by experts. In addition, the test-retest reliability of TANT-Revised was high in both the normal and aphasia groups, implying the TANT-Revised is an efficient instrument for confrontation naming ability. However, this study was a preliminary test revision, and insufficient norm data and factors are affecting the test score.

## Introduction

People who have difficulty retrieving words correctly or lose the ability to produce a specific word in different contexts at the time desired suffer from "word-finding difficulty."[1, 2] In patients with aphasia, it is a prominent attribute that indicates lexical retrieval impairment.[3]

The Boston Naming Test (BNT) is the most popular standard visual picture-naming test for lexical processing abilities, consisting of 60 black & white pictures with common easy–difficult words.[4] The BNT is suitable for testing the naming ability of children, adults with brain

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injury or dysfunction, aphasic patients, and of normal adults.[5] The BNT has been developed in various forms, starting from the original version published by Kaplan *et al*. in 1978 as a trial with 85 items.[5] Subsequently, Kaplan, Goodglass, and Weintraub[4] revised it in 1983 with 60 items. Later, a study on normative data was carried out by Van *Gorp et al*. on the elderly using the initial BNT 60-item.[6]

Research related to the validation of BNT has been carried out previously, though most studies on the validity of BNT intended to examine the validity of participants at that time to measure the sensitivity of naming ability.[7-10] Axelrod, Ricker, and Cherry[7] studied the concurrent validity of the BNT in patients diagnosed with psychiatric disorders, while Locascio, Growden, and Corkin[8] examined the validity of the BNT to detect Alzheimer's disease (AD). Zgaljardic *et al*.[9] studied the validity of the BNT in patients with acquired brain injuries to find the convergent validity of the NAB Naming Test correlated with BNT. Furthermore, the validity of the BNT for normal people was studied by Yochim, Kane, and Mueller[10] to assess the convergent validity and discriminant validity of the NAB Naming Test among the elderly and analyze the relationship with BNT. In addition, Madore *et al*.[11] studied the validity of the Verbal Naming Test and the BNT in older veterans to study the convergent and discriminant validity.

For the reliability test, the instrument has been demonstrated to be stable and compatible,[12] especially the revised version of the test for reliability testing. In addition, most of the methods selected to analyze reliability are test-retest. The study of the range of reliability in BNT has retest periods within two weeks, 1 month, 2 months, 8 months, and once a year. [13-17] Most previous studies tested healthy people with no neurological disorders.[13-15,17] The study by Flanagan and Jackson showed a test-retest reliability for BNT at 0.91, while Murray revealed a test-retest reliability for BNT at 0.96, and Sawrie *et al*.[13,15,16] showed a test-retest reliability for BNT at 0.94. Mitrushina and Satz carried out a test-retest for the reliability of BNT the first and second time at 0.62, the second and third time at 0.65, and the first and third time at 0.89.[17] Except for the study by Sawrie *et al*. tested the abilities of patients with epilepsy, the test-retest reliability of BNT was 0.94.[16]

The original BNT was in English. However, when translated for use in other languages, BNT's effectiveness in assessing naming ability is affected due to English's possible unsuitability with the translated languages' native cultures.[18-21] Therefore, the BNT-60 item was constructed for development in different languages, including Brazilian Portuguese, Korean, Malaysian, Greek,  Spanish, Indonesian, and Thai.[14,20,22-26]

In Thailand, Koonchit developed the Thai Adaptation of Naming Test (TANT) to study naming ability among Thai people in Bangkok aged between 20-86 years.[14] The results revealed that younger subjects scored significantly higher than elderly subjects (*p*<0.01). TANT's testing and scoring criteria are constructed in accordance with the standard instruction in the original BNT.[14] The TANT is

also an instrument used by SLPs for naming ability tests in patients with aphasia. Prasurdeengam used the TANT for a comparative study on naming ability in Thai patients with aphasia.[27] She found that a group of patients with pathological conditions, including posterior aphasia, had significant mean scores for spontaneous correct responses and percentage for naming ability after semantic cues than those with anterior aphasia (*p*<0.05); semantic cues may have improved word comprehension difficulties in this group of patients.[27]

As time passes, the frequency of some words used in the TANT does not communicate the current age or the scarcity of use in today's daily communication. Therefore, the researcher aimed to revise the TANT for improved suitability to the current context. The TANT-Revised was prepared by word replacement using the same semantic categories. Words in the same categories were matched with their semantic cues, which would describe the words for the particular subjects in the case of naming failures. The selected naming words were sought from the Royal Thai Institute Dictionary 2011 and the corpus of Bandhumedha.[28,29] Then, all 60 items were re-ordered by word frequency from the Thai National Corpus (TNC).[30]

According to the test process, the standard instructions from the original BNT and TANT were used for each picture, allowing 20 seconds to answer. Test completion was stopped in the case of six consecutive failures. In addition, stimulus cues were used in any case of misperception or lack of recognition. However, phonemic cues were used in the case of incorrect answers after cueing, which included the initial consonant and vowel for that word.[4,14,27,31] The TANT-Revised uses different scoring criteria compared to the TANT in that if a subject responds with a spontaneous answer, it scores 1 point, while a correct answer after using the semantic cue scores 0.5 points, and a correct answer after using the phonemic cue scores 0.25 points. The total score is the sum of all correct answers.

The TANT revised version has not been assessed for psychometric properties. Thus, this research aims to study the validity and reliability of the TANT-Revised.

## Materials and methods

This study was designed as an experimental study. The study was divided into two stages. The first stage was validity testing by five expert SLPs. The second stage was reliability testing by using the TANT-Revised in the aphasia group and the normal group.

Data collection started from April 2021 to February 2022 after the project was approved by the Human Research Ethics Unit for the Faculty of Medicine, Ramathibodi Hospital (COA. No. MURA2021/318 Ref. 1335), and informed consent was received from all participants.

### Subjects

Participants were recruited for this study. They would attend to the stage of reliability testing. The subjects include patients, caretakers, and visitors at the Speech and Language Clinic and Department of Rehabilitation

Medicine from the Faculty of Medicine Ramathibodi Hospital and Golden Jubilee Medical Center, Faculty of Medicine Siriraj Hospital. They were adults aged ≥ 20 years, divided into 2 groups comprising an aphasia group and a normal group consisting of 13 subjects in each group.

The inclusion criteria for the normal subjects in this study included: (1) healthy adults; and (2) a score for the Mini-Mental State Examination Test (MMSE-Thai) >23 points.[32] The exclusion criteria for normal subjects included having a medical history of neurological disorders, mental disorders, or problems with communication disorders. In the aphasic subjects, inclusion criteria included: (1) being diagnosed by neurologists as having aphasia for at least 6 months post-onset; (2) having pathological conditions for a left-hemisphere stroke; and (3) having scored ≥40 points for the Aphasia Quotient (AQ) from the Thai Adaptation of Western Aphasia Battery Test (WAB) or having a mild to moderate severity level due to being severe if the score is lower than this.[27] All participants are native Thai speakers living in Bangkok and the Metropolitan Region, graduated from elementary school or higher, and have no hearing and eyesight/vision problems.

### Data collection and statistical analysis
#### Validity testing
The TANT-Revised with adapted pictures that suited the cultural context was forwarded for content validity testing. The measurement of content validity consists of Content Validity Index (CVI), Content Validity for Item (I-CVI), and Content Validity Index for Scale (S-CVI). Five licensed SLPs with more than ten years of experience considered the test as containing contents and pictures that met the objectives of the test and could be used for the naming ability test. The test was revised along with suggestions from the experts in the case of incongruence. The CVI of TANT-Revised was based on criteria of ≥0.80, I-CVI should not be less than 0.78, and S-CVI should not be less than 0.9.[33,34]

#### Reliability testing
TANT-Revised was used to test the reliability of the participants. Test-retest reliability was used to check the stability of the test for naming ability scores. TANT-Revised also tested both groups. After two weeks, the subjects were re-tested using the same methods and scoring criteria. The total test-retest scores for the subjects were calculated for reliability using ICC and interpreted according to Koo and Li.[35]

### Results
#### Validity of the TANT-Revised
The content validity was tested by five expert SLPs. The validity test of the TANT-Revised was divided into two parts. Part 1 comprised new black & white pictures drawn with lining similar to the original ones, while Part 2 included semantic cues for the test pictures. The results of these two parts found that the CVI, S-CVI, and I-CVI passed the criteria and were accepted by the experts, as in Table 1.

**Table 1.** Validity of TANT-Revised.

| TANT-Revised | CVI | S-CVI | I-CVI Median (range) |
|---|---|---|---|
| Part 1: Picture of words | 0.96 | 0.99 | 1 (0.8-1.0) |
| Part 2: Semantic cueing | 0.95 | 0.99 | 1 (0.8-1.0) |

#### Participants' characters
The normal group included four males and nine females aged between 32 and 71 (Mean=55.84; SD=10.65). In the aphasia group, eight males and five females aged between 34-73 years (Mean=56.38; SD=9.42). Their educational level, the MMSE scores for the normal group, an AQ score for the aphasic group, and the aphasia type are presented in Table 2.

According to the test-retest for the naming ability of the TANT-Revised in both groups of participants, the scores for some correct answers used a spontaneous response (SR), semantic cue (SC), and phonemic cue (PC), including incorrect answer or no answer. The normal group obtained the scores in Table 3, while the aphasia group obtained the scores in Table 4.

When data were analyzed by STATA showing the measurement and ICC of the participants in the normal group, which were higher than in the aphasia group, the ICC in the normal group was 0.79 (95% CI=0.16-0.94), and the subjects with aphasia was 0.96 (95% CI=0.45-0.99) (Table 5). These test-retest reliability values implied that the normal group had good reliability, whereas the aphasia group had excellent reliability for test-retest reliability.

### Discussion
#### Validity of the TANT-Revised
The TANT-Revised included some updated words and all new drawings. The psychometric properties of the picture words and the developing semantic cues were studied. The researchers tested its validity. Scoring for itemized pictures and semantic cues was implemented by five experienced assessors. Test completion processes and scoring criteria were arranged, reviewed, and given feedback by the experts. The experts suggested adjusting some of the contents of semantic cues in items 1 and 23 (Appendix 2) due to the descriptions of the words not being appropriate or clear. The researchers revised the test for more suitability, as suggested by the experts. The results shown in Table 1 conclude that the validity of the TANT-Revised, in terms of CVI, I-CVI, and S-CVI was at a very high level for content validity, similar to the study of Koonchit,[14] and accepted

**Table 2.** General data of participants.

| No. | Normal | | | | Aphasia | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Gender | Age (year) | Education | MMSE score | Gender | Age (year) | Education | AQ score | Aphasia type | Duration of illness (year) |
| 1 | Male | 71 | Bachelor degree | 24 | Male | 61 | Doctoral degree | 94.4 | Anomic | 3.1 |
| 2 | Female | 69 | Bachelor degree | 29 | Female | 66 | Elementary school | 53.6 | Broca's | 2.5 |
| 3 | Male | 32 | Bachelor degree | 28 | Male | 34 | Senior high school | 51.8 | Broca's | 5.5 |
| 4 | Female | 59 | Bachelor Degree | 26 | Female | 53 | Senior High School | 67.1 | Transcortical motor | 12 |
| 5 | Female | 63 | Bachelor degree | 29 | Male | 57 | Bachelor degree | 57.6 | Transcortical motor | 2.5 |
| 6 | Female | 56 | Senior high school | 27 | Female | 60 | Middle school | 72.7 | Anomic | 18 |
| 7 | Female | 47 | Vocational certificate | 29 | Male | 60 | Diploma degree | 44.4 | Broca's | 9.1 |
| 8 | Female | 53 | Bachelor degree | 29 | Male | 46 | Elementary school | 93.8 | Anomic | 5.5 |
| 9 | Male | 43 | Bachelor degree | 27 | Male | 52 | Middle school | 67.7 | Transcortical sensory | 0.8 |
| 10 | Male | 60 | Elementary school | 28 | Male | 73 | Bachelor degree | 69.7 | Transcortical sensory | 1.2 |
| 11 | Female | 63 | Doctoral degree | 26 | Female | 57 | Bachelor degree | 93.4 | Anomic | 11.8 |
| 12 | Female | 53 | Bachelor degree | 26 | Female | 55 | Bachelor degree | 91.7 | Anomic | 12 |
| 13 | Female | 57 | Bachelor degree | 26 | Male | 59 | Middle School | 61.6 | Conduction | 1.5 |

**Table 3.** Scores from TANT-Revised in the normal group from test-retest measurement.

| No | The number of answered items | | | | | | | | Interpreted score | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Spontaneous response | | Semantic cue | | Phonemic cue | | No answer/incorrect | | SR+SC+PC | |
| | Test | Retest | Test | Retest | Test | Retest | Test | Retest | Test | Retest |
| 1 | 57 | 57 | 1 | 2 | 1 | 0 | 1 | 1 | 57.75 | 58.00 |
| 2 | 53 | 56 | 5 | 2 | 0 | 2 | 2 | 0 | 55.50 | 57.50 |
| 3 | 51 | 57 | 2 | 1 | 2 | 0 | 5 | 2 | 52.50 | 57.50 |
| 4 | 58 | 58 | 0 | 0 | 0 | 0 | 2 | 2 | 58.00 | 58.00 |
| 5 | 54 | 59 | 3 | 1 | 1 | 0 | 2 | 0 | 55.75 | 59.50 |
| 6 | 53 | 56 | 4 | 2 | 2 | 2 | 1 | 0 | 55.50 | 57.50 |
| 7 | 52 | 57 | 1 | 2 | 4 | 0 | 3 | 1 | 53.50 | 58.00 |
| 8 | 57 | 56 | 2 | 3 | 1 | 1 | 0 | 0 | 58.25 | 57.75 |
| 9 | 54 | 54 | 1 | 2 | 1 | 2 | 4 | 2 | 54.75 | 55.50 |
| 10 | 46 | 43 | 5 | 9 | 3 | 4 | 6 | 4 | 49.25 | 48.50 |
| 11 | 55 | 56 | 3 | 3 | 1 | 1 | 1 | 1 | 56.75 | 57.75 |
| 12 | 55 | 56 | 2 | 3 | 2 | 0 | 1 | 1 | 56.50 | 57.50 |
| 13 | 56 | 59 | 4 | 1 | 0 | 0 | 0 | 0 | 58.00 | 59.50 |
| Mean | | | | | | | | | 55.53 | 57.11 |
| SD | | | | | | | | | 2.58 | 2.76 |

**Table 4.** Scores from TANT-Revised in the aphasia group from test-retest measurement.

| No | The number of answered items | | | | | | | | Interpreted score | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Spontaneous response | | Semantic cue | | Phonemic cue | | No answer/incorrect | | SR+SC+PC | |
| | Test | Retest | Test | Retest | Test | Retest | Test | Retest | Test | Retest |
| 1 | 49 | 53 | 5 | 2 | 1 | 2 | 5 | 3 | 51.75 | 54.50 |
| 2 | 32 | 29 | 3 | 5 | 5 | 5 | 20 | 21 | 34.75 | 32.75 |
| 3 | 17 | 15 | 2 | 5 | 14 | 14 | 27 | 26 | 21.50 | 21.00 |
| 4 | 13 | 18 | 5 | 6 | 10 | 18 | 28 | 18 | 18.00 | 25.50 |
| 5 | 27 | 33 | 0 | 2 | 12 | 12 | 17 | 13 | 30.00 | 37.00 |
| 6 | 34 | 41 | 5 | 2 | 9 | 7 | 12 | 10 | 38.75 | 43.75 |
| 7 | 6 | 8 | 2 | 3 | 12 | 14 | 32 | 29 | 10.00 | 13.00 |
| 8 | 41 | 54 | 8 | 2 | 3 | 1 | 8 | 3 | 45.75 | 55.25 |
| 9 | 45 | 50 | 8 | 2 | 5 | 5 | 2 | 3 | 50.25 | 52.25 |
| 10 | 24 | 25 | 1 | 2 | 8 | 14 | 22 | 19 | 26.50 | 29.50 |
| 11 | 44 | 49 | 3 | 1 | 4 | 6 | 9 | 4 | 46.50 | 51.00 |
| 12 | 38 | 45 | 8 | 6 | 9 | 4 | 5 | 5 | 44.25 | 49.00 |
| 13 | 35 | 48 | 9 | 3 | 8 | 4 | 8 | 5 | 41.50 | 50.50 |
| Mean | | | | | | | | | 35.34 | 39.61 |
| SD | | | | | | | | | 13.21 | 14.11 |

*Notes: In the first test, Subjects 4, 5, 7, and 10 in the aphasia group had six consecutive failures. Thus, the subjects had to stop completing the test, which had already gone through until the final part. Moreover, In the second test, Subject 7 also had six consecutive failures in the retest. Thus, this subject had to stop completing the test, which had already gone through until the final part.*

**Table 5.** Display of test-retest reliability utilizing ICC analysis for the normal group and aphasia group.

| Group | ICC (Average) | 95 % Confident interval |
|---|---|---|
| Normal | 0.79 | 0.16-0.94 |
| Aphasia | 0.96 | 0.45-0.99 |

by the experts as being an appropriate test for naming ability. This test conformed to a previous study about the measurement of the BNT, which concluded that the BNT had concurrent validity, sensitivity, verbal intellectual abilities, and naming performance with significantly excellent interest agreement, including high convergent validity and discriminant validity of the NAB naming test.[7,9,10] In addition, the BNT was suitable for the detection of sensitivity and differences between patients with mild and severe Alzheimer's Disease.[8]

*Picture naming in TANT-Revised*

A few subjects in the normal group (3.58%) had incorrect answers at different orders along the test. It was found that the number of incorrect answers increased for the last ten items of the test, which conformed to the study of Nicholas *et al*.[36] These wrong answers for the normal group could occur for those who might name words that were semantically related to the target words, e.g., the name "Lion" instead of "Leo," (item 4). When semantic cues were given, they could answer correctly. Some words that only a few subjects could name correctly might need consideration for future test revision. Incorrect

answers were different in the aphasia group, possibly due to brain injuries or different neurological dysfunctions.[27, 37] The item with the least correct answers was "Asparagus" (item 53), ranked as one of the last ten items in the test. This incorrect answer may be associated with verbal paraphasia and semantically related to the target word. Thus, a replacement was required, e.g., named "Water bamboo shoot"; and perceptual misnaming, e.g., named "Candle".

*Reliability of TANT-Revised*

The TANT-Revised reliability was evaluated using test-retest among the participants (normal and aphasic groups). It was analyzed by ICC. In Table 3, a strong intraclass correlation coefficient (ICC) was presented and interpreted based on the results from the study of Koo and Li as a tool that had high stability for the test-retest examination within 2 weeks.[13] The results were the same as a previous study by Koonchi in which the test-retest reliability was 0.94 (r=0.8-1.0).[14]

The TANT-Revised uses a 60-item format that also had results for test-retest reliability that were similar to the study of Thompson and Heaton, which could

better differentiate patients with naming impairment.[38] Moreover, it had a high correlation with the 85-item version (r=0.96) used to test patients with mental and neurological disorders. The reliability in this study had a strong result similar to the study of a normal group by Mitrushina and Satz to find reliability, which found that test-retest reliability was 0.62-0.89.[17] Murray found the reliability was 0.96 (*p*<0.001).[15] The results also conformed to the study of Flanagan and Jackson, with test-retest reliability of 0.91.[13] Likewise, the study of Sawrie *et al*.[16] demonstrated that test-retest reliability was 0.94 in patients with epilepsy.

The TANT-Revised in this study had high reliability, implying that it could be a good tool for assessment in both normal and aphasia groups. Because of several issues, such as selecting words for naming from the Thai dictionary, which is a source of data for accepted terms, the frequency of words is more suited for communications, including the test-retest reliability process within two weeks according to the theory in the study by Streiner and Norman.[12] Moreover, the lining of word pictures from the TANT-Revised implied that the words were good for the imagination of participants. Whenever they see the pictures, they can recognize and name them.[39]

### *Limitations of the study*

All participants were recruited from clinical settings. It might not represent all aphasia patients in the community. The TANT-Revised has no sufficiently normative data or cut-off points for naming ability assessment in a study for large groups. Thus, those using the TANT-Revised should be aware of the word frequency because the frequency data from the Thai National Corpus may sometimes need to be updated. As a result, the word frequency remains subject to change. Therefore, they might be reordered for a new set in future studies.

### *Future study*

Data should be collected to find the norms and cut-off points in larger groups, which could be used as the norms of Thais for naming ability. This study does not control for gender, age, or education factors. Thus, it could not be concluded whether such factors have any effect on the score of the test. There should be studies on the factors of education, age, gender, or aphasia type that might affect word retrieval ability by TANT-Revised.

### Conclusion

This study aimed to assess the validity and reliability of the TANT (revised version). The test was revised to reflect updated words and suitable semantic cues for better understanding and accuracy in terms of score calculation.

The revised test was examined for validity by five expert SLPs, with their opinions toward target words correlated with pictures and semantic cues. The CVI, S-CVI, and I-CVI were high, implying that the acceptance from the experts confirmed its suitability as a naming ability test. The reliability measurement with the test-retest method

in the normal and aphasia groups used ICC. It was found that the tool had high reliability for both groups.

### Conflict of interest

The authors declare no conflict of interest.

### References

[1] Rohrer JD, Knight WD, Warren JE, Fox NC, Rossor MN, Warren JD. Word-finding difficulty: A clinical analysis of the progressive aphasias. Brain. 2008; 131(Pt 1): 8-38. doi: 10.1093/brain/awm251.

[2] Benson DF. Neurologic correlates of anomia. Studies in neurolinguistics. 1979; 4: 293-328.

[3] Goodglass H, Wingfield A. Word-finding deficits in aphasia: Brain-behavior relations and clinical symptomatolog. In: Goodglass H, Wingfield A, editors. Anomia: neuroanatomical and cognitive correlates. San Diego: Academic Press; 1997.

[4] Kaplan E, Goodglass H, Weintraub S. Boston Naming Test. Philadelphia: Lea & Febiger; 1983.

[5] Roth C. Boston Naming Test. In: Kreutzer J, DeLuca J, Caplan B, Editors. Encyclopedia of clinical neuro-psychology. New York: Springer; 2011. p. 428-35.

[6] Van Gorp WG, Satz P, Kiersch ME, Henry R. Normative data on the Boston Naming Test for a group of normal older adults. J Clin Exp Neuropsychol. 1986; 8(6): 702-5. doi: 10.1080/01688638608405189.

[7] Axelrod BN, Ricker JH, Cherry SA. Concurrent validity of the MAE visual naming test. Arch Clin Neuropsychol. 1994; 9(4): 317-21.

[8] Locascio JJ, Growdon JH, Corkin S. Cognitive test performance in detecting, staging, and tracking Alzheimer's disease. Arch Neurol. 1995; 52(11): 1087-99. doi: 10.1001/archneur.1995.00540350081020.

[9] Zgaljardic DJ, Oden KE, Dickson S, Plenger PM, Lambert ME, Miller R. Naming test of the neuro-psychological assessment battery: Reliability and validity in a sample of patients with acquired brain injury. Arch Clin Neuropsychol. 2013; 28(8): 859-65. doi: 10.1093/arclin/act037.

[10] Yochim BP, Kane KD, Mueller AE. Naming test of the neuropsychological assessment battery: Convergent and discriminant validity. Arch Clin Neuropsychol. 2009; 24(6): 575-83. doi: 10.1093/arclin/acp053.

[11] Madore MR, Scott TM, Fairchild JK, Yochim BP. Validity of the Verbal Naming Test and Boston Naming Test in a sample of older veterans. Clin Neuropsychol. 2020; 36(7): 1679-90. doi: 10.1080/13854046.2020.1861658.

[12] Streiner DL, Norman GR, Cairney J. Health measurement scales: A practical guide to their development and use. New York: Oxford University Press; 2015.

[13] Flanagan JL, Jackson ST. Test-retest reliability of three aphasia tests: Performance of non-brain-damaged older adults. J Commun Disord. 1997; 30(1): 33-43. doi: 10.1016/s0021-9924(96)00039-1.

[14] Koonchit S. A study of naming ability in normal Thai adults based on age and educational in Bangkok using the Thai adaptation of naming test [MA Thesis].

Bangkok: Mahidol University; 2004.

[15] Murray JL. Test-retest reliability of the Boston Naming Test and the Visual Naming Test on normal subjects with a comparison to subjects with complex partial seizure disorder. [MA Thesis]: University of Windsor; 1996.

[16] Sawrie SM, Chelune GJ, Naugle RI, Lüders HO. Empirical methods for assessing meaningful neuro-psychological change following epilepsy surgery. J Int Neuropsychol Soc. 1996; 2(6): 556-64. doi: 10.1017/s1355617700001739.

[17] Mitrushina M, Satz P. Repeated testing of normal elderly with the Boston Naming Test. Aging (Milano). 1995; 7(2): 123-7. doi: 10.1007/BF03324301.

[18] Barker-Collo S. Boston Naming Test performance of older New Zealand adults. Aphasiology. 2007; 21(12): 1171-80. d doi: 10.1080/02687030600821600

[19] Leite KSB, Miotto EC, Nitrini R, Yassuda MS. Boston Naming Test (BNT) original, Brazilian adapted version and short forms: Normative data for illiterate and low-educated older adults. Int Psychogeriatr. 2017; 29(5): 825-33. doi: 10.1017/S1041610216001952.

[20] Miotto EC, Sato JoR, Lˈcia MCSd, Camargo CnHP, Scaff M. Development of an adapted version of the Boston Naming Test for Portuguese speakers. Braz J Psychiatry. 2010; 323: 279-82. doi: 10.1590/s1516-44462010005000006.

[21] Roberts PM, Doucet N. Performance of French-speaking Quebec adults on the Boston Naming Test. Can J Speech-Lang Pathol Audiol. 2011; 35(3): 254-67.

[22] Kim H, Na DL. Normative data on the Korean version of the Boston Naming Test. J Clin Exp Neuropsychol. 1999; 21(1): 127-33. doi: 10.1076/jcen.21.1.127.942.

[23] Dort S, Vong E, Razak R, Kamal R, Meng H. Normative data on a Malay version of the Boston Naming Test. Jurnal Sains Kesihatan Malaysia. 2007; 5(1): 27-36.

[24] Patricacou A, Psallida E, Pring T, Dipper L. The Boston Naming Test in Greek: Normative data and the effects of age and education on naming. Aphasiology. 2007; 21(12): 1157-70.

[25] Peña-Casanova J, Quiñones-Úbeda S, Gramunt-Fombuena N, Aguilar M, Casas L, Molinuevo JL, *et al*. Spanish Multicenter Normative Studies (NEURONORMA Project): Norms for Boston Naming Test and Token Test. Arch Clin Neuropsychol. 2009; 24(4): 343-54. doi: 10.1093/arclin/acp039.

[26] Sulastri A, Utami M, Jongsma M, van Luijtelaar G. The Indonesian Boston Naming Test: Normative data among healthy adults and effects of age and education on naming ability. Int J Sci Res. 2018;8 : 134-9.

[27] Prasurdeengam K. The comparison of naming ability of Thai anterior and posterior aphasic patients using Thai Adaptation of Naming Test [MA Thesis]. Bangkok: Mahidol University; 2010.

[28] The Royal Institute of Thailand. Dictionary of the Royal Institute 2011, 2nd Edition. Bangkok: Nanmeebooks Publications; 2013. (in Thai)

[29] Bandhumedha N. Khlang Kham [Thai language idioms and usage dictionary]. 9th Edition. Bangkok: Amarin Printing and Publishing; 2020. (in Thai)

[30] Thai National Corpus (TNC) under the Royal Patronage of H.R.H. Princess Maha Chakri Sirindhorn [Internet]. 2007 [cited 20 May 2021]. Available from: http://www.arts.chula.ac.th/~ling/tnc3/. (in Thai)

[31] Kaplan E, Goodglass H, Weintraub S, Segal O, Loon-Vervoorn Av. Boston Naming Test. Austin,TX: Pro-ed; 2001.

[32] Ministry of public health. Manual of screening/assessment in geriatrics. WVO Officer of Printing Mill: Bangkok; 2015 (in Thai)

[33] Srisatidnarakul B. Development and validation of research instruments: Psychometric properties. Chulalongkorn University Printing House: Bangkok; 2012. (in Thai)

[34] Polit DF, Beck CT. The content validity index: are you sure you know what's being reported? Critique and recommendations. Res Nurs Health. 2006; 29(5): 489-97. doi: 10.1002/nur.20147.

[35] Koo TK, Li MY. A guideline of selecting and reporting intraclass correlation coefficients for reliability research. J Chiropr Med. 2016; 15(2): 155-63. doi: 10.1016/j.jcm.2016.02.012.

[36] Nicholas LE, Brookshire RH, Maclennan DL, Schumacher JG, Porrazzo SA. Revised administration and scoring procedures for the Boston Naming Test and norms for non-brain-damaged adults. Aphasiology. 1989; 3(6): 569-80.

[37] Kohn SE, Goodglass H. Picture-naming in aphasia. Brain Lang. 1985; 24(2): 266-83. doi: 10.1016/0093-934x(85)90135-x.

[38] Thompson LL, Heaton RK. Comparison of different versions of the Boston Naming Test. Clin Neuropsychol. 1989; 3(2): 184-92.

[39] Janet P, Chapey R. Assessment of language disorders in adults. In: Chapey R, Editor. Language intervention strategies in aphasia and related neurogenic communication disorders 5th Ed. New York: Lippincott Williams & Wilkins; 2008. p. 64-152.

**Appendix 1.** Word items and semantic cue of TANT

| No | Item | Semantic cue | No | Item | Semantic cue |
|---|---|---|---|---|---|
| 1 | ต้นไม้ | - | 31 | วงเวียน | สำหรับวาดกลม |
| 2 | กรรไกร | ใช้ตัด | 32 | ตั๊กแตน | แมลง |
| 3 | หวี | ใช้แต่งผม | 33 | ฮิปโปโปเตมัส | - |
| 4 | ดอกไม้ | - | 34 | เปลญวน | ใช้นอน |
| 5 | เลื่อย | เครื่องมือช่าง | 35 | หนุมาน | ตัวละครในรามเกียรติ์ |
| 6 | แปรงสีฟัน | ใช้ในปาก | 36 | สมอ | อุปกรณ์เรือ |
| 7 | ดอกเห็ด | กินได้ | 37 | บ่วง | ใช้แขวนคอ |
| 8 | ไม้แขวนเสื้อ | พบในตู้ | 38 | บ้านเรือนไทย | - |
| 9 | ธนู | ใช้ยิง | 39 | รถเข็นล้อเดียว | - |
| 10 | พวงหรีด | ใช้ในงานศพ | 40 | บุ้งกี๋ | - |
| 11 | ตะเกียบ | ใช้คีบอาหาร | 41 | กระบองเพชร | พืชในทะเลทราย |
| 12 | กลอน | อยู่ที่ประตู | 42 | หอยทาก | - |
| 13 | เตียง | ใช้นอน | 43 | เกมส์โดมิโน | - |
| 14 | ดินสอ | ใช้เขียน | 44 | นกกระจอกเทศ | - |
| 15 | ขลุ่ย | เครื่องดนตรี | 45 | กล้องจุลทรรศน์ | - |
| 16 | ไม้กวาด | ใช้ทำความสะอาด | 46 | หน่อไม้ฝรั่ง | - |
| 17 | ชฎา | ที่สวมศีรษะ | 47 | หน้าจั่ว | ส่วนประกอบของบ้าน |
| 18 | ประทัด | ใช้ในเทศกาลจีน | 48 | เรือสำเภาจีน | - |
| 19 | บันไดเลื่อน | - | 49 | พิณ | เครื่องดนตรี |
| 20 | ลูกคิด | ใช้คิดเลข | 50 | สิงห์ | สัตว์ในวรรณคดี |
| 21 | กรวย | ใช้ในการเท | 51 | โตก | ใช้ใส่อาหาร |
| 22 | คีม | เครื่องมือ | 52 | หีบเพลงปาก | เครื่องดนตรี |
| 23 | อูฐ | สัตว์ที่อยู่ในทะเลทราย | 53 | ตะกร้อปาก | ใช้กับสุนัข |
| 24 | อนุสาวรีย์ประชาธิปไตย | - | 54 | บายศรี | ใช้ในงานพิธี |
| 25 | เฮลิคอปเตอร์ | - | 55 | ตั่ง | ใช้นั่ง |
| 26 | โปรแทรกเตอร์ | ใช้วัดมุม | 56 | ไม้ระแนง | ใช้ในสวน |
| 27 | ตาลปัตร | เครื่องใช้ของพระ | 57 | แอก | ใช้ในงานเกษตร |
| 28 | มะม่วงหิมพานต์ | - | 58 | หีบเพลงมือ | เครื่องดนตรี |
| 29 | ภูเขาไฟ | ภูเขาชนิดหนึ่ง | 59 | ฝาละมี | ฝาหม้อโบราณ |
| 30 | ม้าน้ำ | สัตว์ทะเล | 60 | ทับทรวง | เครื่องประดับบริเวณหน้าอก |

*Note: (-) Semantic cues of the original words from TANT that had not been available before.*

**Appendix 2.** Word items and semantic cue of TANT-Revised

| No | Item | Semantic cue | No | Item | Semantic cue |
|----|------|-------------|-----|------|-------------|
| 1 | ดอกไม้ | ส่วนที่ผลิออกจากต้นหรือกิ่งของต้นไม้ | 31 | คีม | เครื่องมือ |
| 2 | ต้นไม้ | เป็นพืชทั่วไป | 32 | ลูกคิด | ใช้คิดเลข |
| 3 | เตียง | ใช้นอน | 33 | ชฎา | ที่สวมศีรษะ |
| 4 | สิงห์ | สัตว์ในวรรณคดี | 34 | ชักโครก* | ที่นั่งถ่ายอุจาระ |
| 5 | กลอน | อยู่ที่ประตู | 35 | หนุมาน | ตัวละครในรามเกียรติ์ |
| 6 | ธนู | ใช้ยิง | 36 | เต็นท์* | ที่พักอาศัยชั่วคราว |
| 7 | ดินสอ | ใช้เขียน | 37 | ฉิ่ง* | เครื่องดนตรีประเภทตี |
| 8 | ไม้แขวนเสื้อ | พบในตู้ | 38 | บ้านเรือนไทย | ที่อยู่อาศัย |
| 9 | พิณ | เครื่องดนตรี | 39 | ม้าลาย* | เป็นสัตว์ที่มี 4 ขา |
| 10 | หวี | ใช้แต่งผม | 40 | ประทัด | ใช้ในเทศกาลของจีน |
| 11 | ตะเกียบ | ใช้คีบอาหาร | 41 | บายศรี | ใช้ในงานพิธี |
| 12 | อนุสาวรีย์ประชาธิปไตย | สถานที่ตั้งอยู่กึ่งกลางวงเวียนบนถนน | 42 | หอยทาก | สัตว์ที่มีเปลือกแข็งหุ้ม |
| 13 | พวงมาลัย* | อุปกรณ์บังคับรถหรือเรือ | 43 | แปรงสีฟัน | อุปกรณ์ที่ใช้ทำความสะอาดในช่องปาก |
| 14 | กรวย | ใช้ในการเท | 44 | นกกระจอกเทศ | สัตว์ปีกขนาดใหญ่ |
| 15 | ภูเขาไฟ | ภูเขาชนิดหนึ่ง | 45 | โจงกระเบน* | ผ้านุ่งชนิดหนึ่ง |
| 16 | ไม้กวาด | ใช้ทำความสะอาด | 46 | พวงหรีด | ใช้ในงานศพ |
| 17 | อูฐ | สัตว์ที่อยู่ในทะเลทราย | 47 | ลูกเต๋า* | วัตถุทรงเหลี่ยมมีหกหน้า |
| 18 | กรรไกร | ใช้ตัด | 48 | ม้าน้ำ | สัตว์ทะเล |
| 19 | ขลุ่ย | เครื่องดนตรี | 49 | แว่นขยาย* | ใช้สำหรับส่องดูให้เห็นเป็นภาพขยาย |
| 20 | เรือใบ* | พาหนะทางน้ำชนิดหนึ่ง | 50 | บันไดเลื่อน | ใช้เดินขึ้นลง |
| 21 | เลื่อย | เครื่องมือช่าง | 51 | โต๊ะหมู่บูชา* | ที่วางเครื่องสักการะต่างๆ |
| 22 | เฮลิคอปเตอร์ | พาหนะที่เดินทางบนฟ้า | 52 | มะม่วงหิมพานต์ | ไม้ผลชนิดหนึ่ง |
| 23 | บ่วง | เชือกที่ทำเป็นวงสำหรับคล้อง | 53 | หน่อไม้ฝรั่ง | เป็นผักชนิดหนึ่ง |
| 24 | ระนาด* | เครื่องดนตรีประเภทตี | 54 | โตก | ใช้วางอาหาร |
| 25 | สมอ | อุปกรณ์เรือ | 55 | ฝาชี* | สำหรับครอบอาหาร |
| 26 | ตั๊กแตน | แมลง | 56 | กระบองเพชร/ ตะบองเพชร | พืชในทะเลทราย |
| 27 | มอเตอร์ไซค์* | รถที่มีล้อสองล้อ | 57 | ตาลปัตร | เครื่องใช้ของพระ |
| 28 | กล้องจุลทรรศน์ | อุปกรณ์สำหรับมองวัตถุขนาดเล็ก | 58 | บุ้งกี๋/ปุ้งกี๋ | ใช้โกยดิน |
| 29 | วงเวียน | สำหรับวาดวงกลม | 59 | เปลญวน | ใช้นอน |
| 30 | มังคุด* | ผลไม้ชนิดหนึ่ง | 60 | เกือกม้า* | เหล็กรูปโค้ง |

*Note: Asterisk (*) = Revised word items.*