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The adaptation process of the Comprehensive Aphasia Test into CAT-Turkish: psycholinguistic and clinical considerations

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ABSTRACT

Background and Aim: Cross-linguistic adaptations of aphasia assessment tools in Turkey are needed to improve aphasia assessment and rehabilitation with individuals speaking languages other than well-resourced languages. Aligned with this need, we conducted several studies to propose an adaptation of "The Comprehensive Aphasia Test" (CAT) into Turkish.

Methods: During this adaptation process; (a) lexical/linguistic and visual stimuli in CAT's Language Battery subtests were evaluated by examining their imageability, familiarity, and name agreement features through rating studies, and two pilot studies for (b) Cognitive Screening and (c) Language Battery sections were carried out. In the stimuli norming studies, 71 undergraduate students (aged 20–24) rated 236 words in the *Imageability* and *Familiarity* tasks; 40 participants (aged 30–60) named 244 pictures in the *Name Agreement* task. Two sections of the CAT-TR were administered to different groups of subjects with aphasia (PWA) and matched controls. Fourteen PWA (and 14 controls) were presented the Cognitive Screening section, and a different group (PWA = 20, controls = 20) completed the Language Battery section.

Results: The imageability and familiarity ratings of 236 words and name agreement (% – H statistic) values of 244 pictures were calculated. Imageability and familiarity ratings of the words had a positive strong correlation with each other. Items with a name agreement of 85% or more were considered high name agreement. As anticipated, the control groups both in the Cognitive Screening and the Language Battery sections performed better than the PWA group. As a result, no further adaptive changes were suggested for these sections.

Conclusion: Results of these studies have shown that the Comprehensive Aphasia Test-Turkish is culturally and linguistically appropriate for Turkish speakers with aphasia. Therefore, future studies should assess its validity and reliability, and establish norms for its clinical interpretation.

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1. Introduction

Stroke is the third leading cause of death in Turkey, and those who survive may need long-term assistance (Öztürk, 2014). Approximately one-third of stroke survivors develop aphasia which impacts the ability to produce and comprehend spoken language, to read and write, and to use numbers and gestures. The impact of aphasia may go beyond the language and speech problems; including physical (e.g., fatigue), cognitive (e.g., memory, attention, neglect), and psychological (e.g., depression, anxiety) domains (Maviş, 2010).

When it comes to people with aphasia (PWA), language assessment examines the aphasia severity and evaluates whether and how different language domains are affected such as reading, writing, speaking and comprehension. Aphasia assessment also guides speech and language therapists (SLTs) to decide on the intervention tailored to PWA's needs and their family members (Murray & Coppens, 2016). A recent review indicates that there are presently 56 aphasia assessment tools available for English-speaking individuals (Rohde et al., 2018); examples of these include the Boston Diagnostic Aphasia Examination (BDAE; Goodglass & Kaplan, 1972) and Western Aphasia Battery (WAB; Kertesz, 1982) based on Localization Theory, and the Comprehensive Aphasia Test (CAT; Swinburn et al., 2004) and Psycholinguistic Assessment of Language Processing in Aphasia (PALPA; Kay et al., 1996) utilizing the cognitive neuropsychological approach.

There are Turkish-specific aphasia tests used by SLTs in clinical practice (e.g., Aphasia Language Assessment Test (Maviş & Toğram, 2009) and Gülhane Aphasia Test-2 (Maviş et al., 2007). These tests aim to assess the patient's strengths and weaknesses of language abilities, to identify short and long-term goal settings, and to decide whether the patient needs intervention in terms of receptive and expressive language abilities. On the other hand, these tests do not compare individual performance or present error analysis across language modalities. It has to be acknowledged that, the scores obtained from these tests may not hold any direct equivalence to the assessment tools utilized in the English-speaking population due to their language-specific nature (Wallace et al., 2020).

The CAT has been adapted into 14 languages including Turkish (the CAT-TR) by the Collaboration of Aphasia Trialists (CATs). The test provides a detailed assessment of PWA across three different subsections: Cognitive Screen, Language Battery, and Disability Questionnaire (recently updated as Aphasia Impact Questionnaire-21). The Cognitive Screen focuses on assessing cognitive abilities that may impact aphasia assessment and rehabilitation. The Language Battery shapes the main body of the test. It aims to assess language performance within various modalities (e.g., spoken and written word comprehension, naming, etc.). The Disability Questionnaire assesses the quality of life of the PWA from their perspective. The CAT was originally developed in the UK for English speakers. The items in the test were modeled and based on the psycholinguistic variables including imageability, frequency, syllable length, morphological complexity, orthographic regularity through which the clinicians could perform error analysis. As it is based on the cognitive neuropsychological approach, the test performance does not yield any aphasia classification (Howard et al., 2010; Swinburn et al., 2004; Whitworth et al., 2014).

The underlying rationales to adapt the CAT into 14 languages read as follows: (i) The test will serve as a uniform assessment tool to be shared among members of Collaboration of Aphasia Trialists, enabling the assessment of PWA speaking different languages with diverse cultural backgrounds (Brady et al., 2014). (ii) It satisfies the

selection criteria of being comprehensive for a wide range of language functions and offering screening for related neuropsychological deficits. (iii) It is also considered clinically useful as it is capable of detecting changes over time and easy to score. (iv) Finally, the CAT-TR will provide significant contributions to the assessment of Turkish-speaking PWA based on the cognitive neuropsychological approach.

It is important to consider language-specific characteristics in the adaptation process. Turkish possesses distinctive linguistic features compared to English. It is incorporated in the Altaic branch of the Ural-Altaic language family. Turkish has the canonical word order of "subject-object-verb" but other orders are acceptable, resulting in six possibilities (SOV, SVO, OSV, OVS, VOS, and VSO). Moreover, Turkish is an agglutinative language. Indeed, it has large inflectional paradigms. These paradigms include numerous suffixes that are attached to the nouns and verbs. Language problems in Turkish PWA have been investigated in studies addressing word order, naming, and repetition. Non-fluent PWA were reported to comprehend the sentences either with SVO or SOV better than those with the other orders (Maviş et al., 2020; Yolcu, 2005). It was also observed that the error profiles of fluent PWA included mostly phonological paraphasias and neologisms during repetition and naming, respectively (Maviş, 2005). A recent preliminary study examined verbal and visuospatial memory in PWA using digit span and Corsi block-tapping tasks (Arslan et al., 2019). The results showed that the non-verbal domain was relatively preserved in aphasia.

This study aims to describe the adaptation process of the original CAT into Turkish (CAT-TR) for the Cognitive Screen and Language Battery Sections. First, the lexical/linguistic and visual stimuli in CAT's Language Battery subtests were evaluated by examining their imageability, familiarity, and name agreement features through stimuli norming studies. Then, two pilot studies for Cognitive Screening and Language Battery sections were carried out.[1]

2. Stimuli norming

When conducting the adaptation studies on tests, it is often desirable to control the words in terms of affective variables. The linguistic features and psycholinguistic variables including word frequency, imageability, word length, phonological and semantic relatedness, orthographic regularity, animacy, morphological complexity, sentence length, and syntactic complexity are the factors that may affect the performance of the participants on a variety of tasks (e.g., Bastiaanse et al., 2009, 2015; Fyndanis et al., 2017; Rofes et al., 2017). Those variables should be taken into consideration in each language for the adaptation of the CAT to ensure the educational or psychological equivalence and to conduct necessary validity studies.

The aim of these stimuli norming studies was to examine imageability, familiarity, and name agreement features of the lexical and visual stimuli in the CAT-TR's Language Battery subtests through rating studies. The rationale was to select adequate material based on the psycholinguistic variables underlying the test items of the original CAT. The following part presents a brief explanation of these psycholinguistic variables and how these variables were controlled during the adaptation process of the CAT-TR.

Stimuli norming study 1: imageability and familiarity

In this stimuli norming study, the focus was to control the selected task items according to the imageability and familiarity. *Imageability* is related with how easily a word evokes a mental image of a thing to which the word refers (Shao & Stiegert, 2016). This variable affects the performance of an individual during the assessment of naming or word recognition; that is, how easily and quickly one elicits the mental images to link the names or words to the pictures is affected by imageability (Ellis & Morrison, 1998). High imageable words elicit shorter response times than low imageable ones, and fewer errors occurred in the assessments of these words (Alario et al., 2004; Bonin et al., 2002; Boukadi et al., 2016; Cortese & Schock, 2013).

Familiarity refers to the subjective frequency of one's exposure to a word (Shao & Stiegert, 2016). It is an important predictor of response time in picture naming; more familiar concepts are named faster (Ellis & Morrison, 1998; Feyereisen et al., 1988).

Methods

The imageability and familiarity tasks for 236 words were administered to seventy-one undergraduate students of Speech and Language Therapy department (54 Female, 17 Male) aged between 20 and 24 (M_{AGE} = 21.18; SD = 1.1). They came from different regions of Turkey and were informed about the purpose and the procedure of the study.

In the first stimuli norming study, imageability and familiarity ratings of the words (i.e., nouns and verbs) were controlled for the subtests *Repetition of words, Naming objects, Reading words, Writing picture names*, and *Writing to dictation* in the Language Battery section of CAT-TR. The imageability and familiarity ratings were subjectively collected due to the lack of corpora for written or spoken language in Turkish. A questionnaire with a 7-point scale containing 236 words was prepared. In addition to the low/high imageable and familiar words, some factors such as animacy, distinctive features, syllable length, morphological complexity, and orthographic complexity were considered at the stage of selecting the words. Several words were related to the CAT's original version and included in the study by direct translation; however, for certain reasons such as phonological distractors, some of these words could not be included. Subtests *Comprehension of spoken words* and *Comprehension of written words* in the Language Battery section have target words with phonological distractors (that differ in consonants); for instance, "**sh**ip" is the target word and "**l**ip" is its phonological distractor in terms of three distinctive features. "Ship" can be translated into Turkish as "gemi"; yet, "gemi" in Turkish does not have any phonological distractor. Therefore, it would not be possible to use the word "ship" [gemi]; instead, "pocket" [cep] was used with its phonological distractor "cap" [kep].

Having been presented with 236 words, the participants were asked to rate "how easy or difficult the words form a mental image in their minds" to test the imageability of the words. In the familiarity task, the participants were asked to rate "how close they have acquaintance with the word". The instructions and information presented to measure the imageability and familiarity were based on Gilhooly and Logie (1980). The participants were asked to rate the imageability/familiarity of the words on a 7-point rating scale where 1 was the least familiar/imageable and 7 was the most familiar/imageable.

Results

According to the data obtained from the seventy-one participants who rated the imageability and familiarity on the 7-point rating scale, the 25th and 75th percentile scores for 236 words were calculated (see Table 1). Whereas words from the 75% range percentile were considered as high imageable/familiar, words from 25% were considered as low imageable/familiar.

The relation between psycholinguistic parameters was analysed using Spearman's rho correlation coefficient. The imageability and familiarity ratings of the words had a positive and strong correlation with each other; as the imageability rating of a word increased, the familiarity rating increased as well (r_s *(236)* = .708, $p < .001$).

Stimuli norming study 2: name agreement

In this second stimuli norming study, it was aimed to determine the pictures of CAT-TR according to the name agreement. *The name agreement* is the degree to which the names given to a picture vary among participants. It is the most important predictor of reaction time and response accuracy in picture naming (Alario et al., 2004). The name agreement of a picture is usually measured by assessing the number of the different names given to a picture by the participants. The greater the number of the different names which a picture reveals, the lower its name agreement is (Bose & Schafer, 2017). For instance, a picture of *trousers* could be named as "trousers", "jeans", "pants"; yet, the pictures with a single dominant response are named more quickly and accurately than those with multiple responses (Alario & Ferrand, 1999). When the word has various alternatives, the lexical selection often takes longer during the naming process (Cuetos et al., 1999). If low name agreement is due to an incorrect description of the images, the problem is probably at the level of structural coding; that is, object recognition. However, if this is the case, since an object can be named by different names, the problem is in the selection stage of the lemma (Boukadi et al., 2016). The pictures with the lower name agreement activate more lemmas than others; therefore, the choice of one among the others takes much longer. In this regard, high name agreement is very crucial to assess response accuracy.

Table 1. Descriptive statistics for imageability and familiarity of 236 words.

Statistics	Imageability	Familiarity
Mean	5.815	5.675
Median	6.382	5.793
SD	1.212	.8626
Range	2.545–7.000	2.786–6.955
25%	4.901	5.042
75%	6.773	6.412

Note. 25% (and below defined as low) and 75% (and above defined as high) are cut-off percentiles for imageability and familiarity. SD, standard deviation.

Methods

Forty participants (25 Female, 15 Male) aged between 30 and 60 (M_{AGE} = 39.37), having voluntary agreement on the procedure, were involved in the name agreement task for 244 pictures.

In this stimuli norming study, the name agreement percentages of two hundred forty-four pictures, to be included in subtests *Comprehension of spoken words, Comprehension of written words, Naming objects, Naming actions, Writing picture names* of the Language Battery section in CAT-TR were controlled. In the mentioned subtests, the names of the pictures were determined according to the variables, such as familiarity, imageability, and distinctive features that are relevant to the tasks. The pictures in the name agreement task were selected from the original CAT (Swinburn et al., 2004), International Picture Naming Project (Szekely et al., 2004), the Croatian version of CAT (Kraljevic et al., 2017), and the study of Snodgrass and Vanderwart (1980). The pictures were black and white drawings on a clear background.

In the name agreement task, the participants were shown the pictures and asked to write the names of the objects and/or actions in the pictures they see or asked to select another option (i.e., "I don't know what it is" (Don't Know Object/Action), "I don't know its name" (Don't Know Name), "Tip of the tongue" (know its name but unable to say it) where they did not know the name. These responses were also considered in the calculation of the name agreement percentages.

Participants' responses to the picture naming task were measured both with the *percentage calculation* and *H-statistic*. The percentage calculation is the proportion of the people who used the same name (the modal name) for a picture, and H-statistic is an index that reflects the number of the alternative names provided by the participants for each picture. H-statistic is computed by using the following formula developed by Snodgrass and Vanderwart (1980): $H = \sum_{i=1}^{k} p_i \log_2\left(\frac{1}{p_i}\right)$, *where* k represents the number of the answers given, and p_i the proportion of the participants who assigned each name. According to Snodgrass and Vanderwart (1980), the *H*-statistic is more reliable and informative than the percentage calculation. There is a negative correlation between the *name agreement* percentage and *H-statistic*; as the *name agreement* percentage increases, *H* is closer to 0; which means the closer is the *H* value of a word to 0, the higher the name agreement value is.

Results

In the name agreement task, participants rated 244 pictures. The name agreement percentages for those and *H*-statistic were calculated for each picture (see Table 2). Only items with the 85% name agreement or more were considered as high name agreement percentage.

The participants rated different sets of the words in two stimuli norming studies, except for 84 words shared in both. They were calculated as shown in Table 3.

A Spearman's rank-order correlation was run to assess the relationship between the imageability, familiarity, and the name agreement ratings (for percentages and *H* values).

There was a statistically significant, weak positive correlation between the imageability ratings and the name agreement percentages (r_s (84) = .268, p = .014); as the imageability rating of a word increased, so did the name agreement percentage. No significant correlation was observed between the familiarity ratings and the name agreement percentage (r_s (84) = .188, p = .087).

Discussion

Consequently, in accordance with the first stimuli norming study the items of the subtests were selected according to the imageability and familiarity ratings. The statistically determined low and high imageability and familiarity cut-offs were detected; that is, 4.901–6.773 for the imageability and 5.042–6.412 for the familiarity, between the 25% and 75% bands respectively (see Rofes et al., 2017 for more details about imageability ratings across languages in CATs). The contrast between the high and low imageability ratings was relevant for the subtests*Repetition of words, Reading words, Naming objects, Writing picture nam*es, and *Writing to dictation*. The Language Battery section of the CAT incorporates a contrast between high and low frequency/familiarity words in subtests *Comprehension of spoken words, Repetition of words, Naming objects, Writing picture nam*es, and *Writing to dictation*.

The results of these studies are in line with the previous studies; when the imageability rating of a word increases, the familiarity rating increases as well. When the name agreement rating (%) of an object increases, the imageability rating also increases (Bonin et al., 2003; Tsaparina et al., 2011). Accordingly, the name agreement value of more imageable words is higher among the participants than the others. This finding is consistent with the literature (Boukadi et al., 2016; Tsaparina et al., 2011).

Table 2. Name agreement, H statistics and percentages of target & modal words.

	Target Word NA		Modal Word NA	
Statistics	*H Statistics*	*Percentage (%)*	*H Statistics*	*Percentage (%)*
Mean	0.523	86.967	0.601	85.240
Median	0.286	95.000	0.297	94.736
SD	0.983	18.902	0.609	16.738
Minimum	0	5.8823	0	29.411
Maximum	12.386	100.00	2.727	100.00

Notes. Target words are the words aimed to take place in CAT-TR; Modal words are the words that most participants named for a picture. H statistics is developed by Snodgrass and Vanderwart (1980) to be used in naming analysis. NA = name agreement

Table 3. Descriptive statistics for imageability and familiarity ratings and NA values of shared words (n = 84).

Statistics	Imageability	Familiarity	NA (H Statistic)	NA (%)
Mean	6.626	6.000	0.320	90.952
Median	6.759	6.274	0.000	95.000
SD	0.414	0.782	0.472	15.167
Minimum	4.773	6.955	2.203	100.00
Maximum	7.000	6.955	2.203	100.00

Note. H statistics is developed by Snodgrass and Vanderwart (1980) to be used in naming analysis.

Identifying the words considering the psycholinguistic and linguistic features is challenging for the typologically different languages. Turkish is one such language in which problems related to the adaptation of the testing material are often encountered in terms of those features (see Fyndanis et al., 2017 for the examples in the comparison of languages). Since morphologically rich languages such as Turkish have few monosyllabic words, it was difficult to find words with low/high imageability and/or high/low familiarity in subtests *Comprehension of Spoken and Written Words*. Additionally, Turkish has a transparent orthography similar to Basque, Greek, Serbian, and Spanish, in which the contrast between regular and irregular words is not available (Fyndanis et al., 2017). When the pronunciation of a word is appropriately produced by the grapheme-sound correspondence rules of a language, it is considered as "regular". When its pronunciation cannot be predicted from these rules it is considered as "irregular" (Ziegler et al., 2003). Having a transparent orthography Turkish was a challenging language to find irregular words in subtests *Reading words, Writing picture names*, and *Writing to dictation*. Words borrowed from the other languages and commonly used in Turkish such as "train" [tren], "crisis" [kriz], "family" [aile], "sport" [spor], etc. were included in these subtests as irregular ones. Finally, we should add that there are two web-based corpora in Turkish providing the frequency ratings of the words in written texts and/or spoken data; one is "TS Corpus" (Sezer & Sever-Sezer, 2013) and the other is "Turkish National Corpus" (Aksan et al., 2012); both of which present more than 50 million words. However, they do not provide imageability and familiarity ratings. Therefore, as part of the adaptation process, the data in this study was subjectively collected.

3. Pilot study I: the cognitive screen

In addition to the deficiencies in language and communication, aphasia might be accompanied by problems in the cognitive domain (Maviş, 2010), such as attention deficits (Murray, 2012), executive function abilities (Purdy, 2002), and difficulties in accessing working memory (Arslan et al., 2019; Caspari et al., 1998).

Researchers have long argued whether cognitive skills directly or indirectly affect language. Quite a number of studies have confirmed that cognitive impairments primarily endanger linguistic skills in patients with aphasia (Fonseca et al., 2016; El Hachioui et al., 2014; Marinelli et al., 2017). Thus, the cognitive characteristics of aphasic individuals should not be ignored in aphasia assessments. As a matter of fact, any cognitive or neuropsychological disorders/deficits may affect PWA's performance in the language assessment. Therefore, examination of patients' non-linguistic cognitive abilities prior to language assessment can assist SLTs in their judgment of individuals' language performance (Nys et al., 2007; Swinburn et al., 2004). Consequently, the developers of CAT included a screening section for "associated cognitive deficits", specifically for visual neglect, ideomotor and ideational apraxia, acalculia/dyscalculia, memory access (in a nonverbal way) (Swinburn et al., 2004). As suggested by the developers, SLTs should assess these deficits further with additional tests as the Cognitive Screening section is not comprehensive (Swinburn et al., 2004).

As a part of this adaptation study the Cognitive Screening section of CAT-TR was administered to a total of twenty-eight Turkish speakers with and without aphasia. In this

pilot study, we seek to investigate the appropriateness of the stimuli for Turkish speaking adults and to control for necessary adaptations.

Methods

Fourteen PWA aged between 21 and 75 (M_{AGE} = 50.5, SD = 14.39) and fourteen matching controls took part in the pilot study of Cognitive Screening (see Table 4 for details). The PWA were recruited from the patient database of Anadolu University, Centre for Speech and Language Disorders (DILKOM). They were assessed, prior to the study by a senior speech therapist with the Aphasia Language Assessment Test in Turkish (ADD; Maviş & Toğram, 2009), and the aphasia types were defined; accordingly, three mild fluent and eleven non-fluent PWA participated in the study. All patients acquired aphasia after stroke.

The inclusion criteria for PWA were a) to be at least three weeks post-stroke onset at the time of testing, b) having no prior history of symptomatic neurological disorders or sensory deficits, and c) to exhibit relatively preserved auditory comprehension.

The control group consisted of fourteen adults, who were individually matched with PWA in terms of age, gender, and years of education. They reported having no history of neurological or physiological disorders.

The Cognitive Screen, the first section of the CAT, consists of 6 subtests (see Table 5 for details) (Swinburn et al., 2004).

Since visual perception is essential for the administration of the whole test, the section starts with the *line bisection* task to control for visual neglect. Participants are asked to bisect three lines of different lengths. The *semantic memory* subtest "assesses access to semantic memory in a nonverbal way" (Swinburn et al., 2004). Participants are required to link the given picture to a semantically associated target item. The *word fluency* subtest asks participants to name items from the category of animals and then words starting with /s/ in 60 seconds respectively. The reason for a verbal subtest to be included in a cognitive screening is to gain a general insight on executive functions; namely, semantic

Table 4. Background information for PWA in the cognitive screen pilot study.

		PWA (n = 14)	Percentage (%)
Sex	Female	6	42.8
	Male	8	57.1
Age	21–25	2	14.2
	41-57	8	57.1
	61–75	4	28.5
Education	Basic (up to 8 years)	6	42.8
	Upper (high school and above)	8	57.1
Aphasia type	Non-fluent	11	78.5
	Fluent	3	21.4
Post onset (months)	1	1	7.1
	7–16	9	64.2
	28-51	3	21.4
	113	1	7.1
Lesion Site	Temporal	2	14.2
	Frontotemporoparietal	1	7.1
	Frontotemporal	1	7.1
	Temporooccipital	1	7.1
	Unknown	9	64.2

Table 5. CAT-TR cognitive screen section.

CAT-TR Cognitive Screen	Maximum Score
Subtest 1. Line Bisection	±6
Subtest 2. Semantic Memory	10
Subtest 3. Word Fluency	Unlimited
Animal	
/k/	
Recognition Memory	10
Gesture-Object Use	12
Arithmetic	6
TOTAL SCORE	**38**

and phonemic fluency (Swinburn et al., 2004). In the *recognition memory* subtest, participants point to the picture they remember/recognize from the semantic memory subtest. The *gesture-object use* subtest detects possible ideomotor and ideational apraxia. Participants demonstrate how they would use the objects shown to them. The last subtest, *arithmetic*, screens for dyscalculia/acalculia. Participants are shown six calculations and asked to point to the correct answer among the five options provided.

The Cognitive Screening section was translated from English to Turkish. The only adaptation made prior to testing was replacing the phoneme /s/ with /k/ in the word fluency subtest as the frequency of the phoneme /k/ in word-initial position is higher than /s/ in Turkish (Tunçer, 2011).

All sessions with PWA were held at Anadolu University, DILKOM. Following the explanation about the study and the procedures, all the participants and their accompanying caregivers gave their written informed consent. All the sessions with PWA were video-recorded for scoring purposes.

All the subtests started with the practice items and the test items were presented once the comprehension of instructions was assured. The scoring procedure of the original CAT was followed (Swinburn et al., 2004).

Results

The data from twenty-eight participants were analysed in IBM SPSS 25 (Statistical Program for Social Sciences). Since the data were not normally distributed, group scores were compared with a non-parametric test – Mann-Whitney U.

The total cognitive score of PWA was lower than the control group and the difference between these two groups was statistically significant (see Table 6 for details). The

Table 6. CAT-TR cognitive screen section performance of PWA and control participants.

	M (SD)			
Subtests	PWA	Healthy	U	p
Line Bisection	1.28(1.25)	.17(1.1)	55.5	.047*
Semantic Memory	7.57(2.82)	8.9(1.07)	115	.418
Word Fluency	3.36(3.85)	26.29(8.28)	194	.001*
Recognition Memory	8.29(2.52)	9.57(.64)	126.5	.149
Gesture-Object Use	9.07(2.70)	11.07(.91)	153.3	.008*
Arithmetic	3(2)	5.43(1.01)	171	.001*
Cognitive Screen Total	27.9(8.18)	35(2.35)	168	.001*

*$p < .05$

comparison of each subtest results between the two groups revealed significant differences on the line bisection, word fluency, gesture-object use, and arithmetic subtests but not for the semantic memory and recognition memory. Additionally, item scores given by the control group for each item of the subtests were checked. The control group's accuracy rate for each subtest item was above 85%, except for the item igloo in the semantic memory subtest, which had a 72% accuracy rate.

Discussion

This pilot study was conducted to determine any necessary modifications on the items and visuals used in the Cognitive Screen section of CAT-TR.

The performance demonstrated by the control group indicated the appropriateness of the stimuli used in this Cognitive Screen section. As expected, the total scores of the PWA group were lower than the matching controls. The subtest scores between the two groups revealed statistically significant differences, except for the semantic memory and recognition memory subtests. Indication of intact access to visual memory in PWA was demonstrated in other adaptations of the test (i.e., Abou El-Ella et al., 2013).

The PWA performed better on comprehension tasks as compared to the tasks that necessitate production of sorts; i.e., limp moves (line bisection and gesture-object use), and verbal production (word fluency). Receiving low scores on tasks requiring verbal production was expected in PWA (Abou El-Ella et al., 2013; Kuvač Kraljevič et al., 2020). As for arithmetic, difficulties with numbers/arithmetic's/calculations depending on the lesion site of the PWA were shown in previous studies (e.g., Dehaene & Cohen, 1997).

The Cognitive Screening section can serve as a useful tool for briefly examining relevant aspects of cognition in aphasia. The results obtained in this pilot study indicated that the Cognitive Screening section of CAT-TR does not appear to need further adaptation.

4. Pilot study II: the language battery

The final aim of this adaptation was to conduct a pilot study in which Turkish-speaking PWA and control participants were tested. The rationale was to examine whether any further modifications were needed regarding the items of the subtests and the instructions. There are two parts in the Language Battery section; Language Comprehension and Expressive Language. There are five subtests in the first part, the remaining sixteen subtests are in the latter. All the subtests and the maximum score information was provided in Table 7.

Methods

The Language Battery of CAT-TR was administered to Turkish-speaking twenty PWA and twenty control participants. Twelve PWA were non-fluent while the remaining 8 were fluent. The age range of the PWA was between 24 and 80 (M_{AGE} = 56.65, SD = 16.26). The inclusion criteria for PWA involved the information regarding the existence of stroke and the affected brain areas provided by the medical records of the patients. ADD was also

Table 7. CAT-TR language battery.

CAT-TR Language Battery	Maximum Score
Part 1: Language Comprehension	
Subtest 7. Comprehension of Spoken Words	30
Subtest 8. Comprehension of Written Words	30
Subtest 9. Comprehension of Spoken Sentences	32
Subtest 10. Comprehension of Written Sentences	32
Subtest 11. Comprehension of Spoken Paragraphs	4
Part 2: Expressive Language	
Subtest 12. Repetition of Words	32
Subtest 13. Repetition of Complex Words	6
Subtest 14. Repetition of Nonwords	10
Subtest 15. Repetition of Digit Strings	14
Subtest 16. Repetition of Sentences	12
Subtest 17. Naming Objects	48
Subtest 18. Naming Actions	10
Subtest 19. Spoken Picture Description	-
Subtest 20. Reading Words	48
Subtest 21. Reading Complex Words	6
Subtest 22. Reading Function Words	6
Subtest 23. Reading Nonwords	10
Subtest 24. Writing: Copying	27
Subtest 25. Writing Picture Names	21
Subtest 26. Writing to Dictation	28
Subtest 27. Written Picture Description	-
TOTAL SCORE	**406**

administered to all PWA for the diagnosis of aphasia. As suggested by the authors of CAT (Swinburn et al., 2004) aphasia assessment later than 3 weeks post-stroke was demanded. The PWA were patients coming for routine clinical neurologic examinations. The control group participants were their spouses or caregivers, who had no neurological or psychiatric complaints prior to the administration. They were presented a research informed consent form including the importance of the study, the expectations from the participants, and the possible benefits of participation. All the PWA and the control group participants agreed to take part in this clinical study, having affirmed the convenience of the research.

The control group involved 20 participants whose age range was between 21 and 89 (M_{AGE} = 57.05, SD = 20.12). The Mini Mental State Examination (MMSE) scores in adults above 60 were at least 23/24, the cut-off score for healthy adults in Turkey (Güngen et al., 2002). The demographic information of PWA and healthy participants were demonstrated in Table 8.

There are two parts and 21 subtests in the Language Battery Section. Subtests 19 and 27 (*Spoken and Written Picture Description*) were not considered for the study owing to the fact that there was yet no maximum score to be obtained as underlined by the authors of the CAT in its manual (Swinburn et al., 2004).

The words considered for psycholinguistic parameters were the target words of *Comprehension of Spoken and Written Words, Repetition of Words, Naming Objects and Actions, Reading Words, Writing Picture Names and Writing to Dictation* subtests.

The items in the Subtests *Comprehension of Spoken and Written Words* were identified through careful consideration of the psycholinguistic variables involving low/high familiarity; semantic, unrelated, and phonological distractors with one to

Table 8. Demographic characteristics of PWA and control participants in the language battery pilot study.

Participants	Aphasia type	Post-Onset Time (Weeks)	Sex	Age	Education (years)
PWA-01	Fluent	4	M	68	5
PWA-02	Fluent	96	F	69	14
PWA-03	Fluent	47	M	73	5
PWA-04	Fluent	77	M	46	16
PWA-05	Fluent	12	F	61	12
PWA-06	Fluent	4	F	30	8
PWA-07	Fluent	126	F	58	5
PWA-08	Fluent	32	M	65	5
PWA-09	Non-F	36	M	58	12
PWA-10	Non-F	232	M	55	12
PWA-11	Non-F	52	F	67	12
PWA-12	Non-F	129	F	24	16
PWA-13	Non-F	21	M	80	5
PWA-14	Non-F	109	F	78	5
PWA-15	Non-F	69	M	52	5
PWA-16	Non-F	121	M	67	12
PWA-17	Non-F	144	M	28	12
PWA-18	Non-F	36	M	37	12
PWA-19	Non-F	116	M	54	12
PWA-20	Non-F	32	M	63	8
Control-01	-	-	F	78	8
Control-02	-	-	F	77	8
Control-03	-	-	F	66	8
Control-04	-	-	F	55	8
Control-05	-	-	F	58	12
Control-06	-	-	F	54	12
Control-07	-	-	F	74	14
Control-08	-	-	F	68	16
Control-09	-	-	F	31	12
Control-10	-	-	F	26	16
Control-11	-	-	M	80	8
Control-12	-	-	M	58	8
Control-13	-	-	M	54	8
Control-14	-	-	M	70	12
Control-15	-	-	M	67	12
Control-16	-	-	M	89	14
Control-17	-	-	M	57	14
Control-18	-	-	M	32	16
Control-19	-	-	M	26	16
Control-20	-	-	M	21	14

three distinctive features. The sentences in Subtests *Comprehension of Spoken and Written Sentences*, and the two paragraphs in Subtest *Comprehension of Spoken Paragraphs* were translated into Turkish with appropriate modifications. Moreover, the proper names including city (London), people (Sally and Richard), distance (miles), and currency (British Pounds) in the Subtest *Comprehension of Spoken Paragraphs* were replaced with the Turkish ones such as Ankara, Selma and Remzi, kilometers, and Turkish Lira, respectively.

In the Expressive Language part, the items in Subtests *Repetition of Words, Naming Objects, Reading Words, Writing Picture Names*, and *Writing to Dictation* were selected based on the variables including imageability (high/low), familiarity (high/low), animacy (living/non-living), syllable length (one-three), orthographic regularity and morphological complexity, where applicable. The items in Subtests *Repetition of Nonwords* and *Reading*

Nonwords were taken from Nonword Repetition Test in Turkish (Topbaş et al., 2014). In Subtest *Repetition of Sentences*, two of the sentences were simply translated into Turkish, which were both semantically and morpho-syntactically equivalent to the original version. However, the remaining six sentences were formed in accordance with the number of content words and morphemes attached to them as stated in the manual. In Subtest *Naming Actions*, the verbs "eat" and "saw" were preserved; yet, the remaining ones were replaced with "read, cry, sit, and drink" whose name agreement values were examined by Selvi (2016) as part of the adaptation process. The items in Subtests *Repetition of Complex Words, Reading Complex Words, Reading Function Words*, and *Writing: Copying* were translated into Turkish with necessary morpho-syntactic modifications due to the agglutinative nature of Turkish.

All assessment sessions with PWA were held at two neurology units in a hospital in Ankara and Eskişehir in quiet therapy rooms. The participants' history and language assessment (ADD) results were obtained from their speech and language files. If there were more than three weeks after the last administration of ADD, the language assessments were revisited.

The assessment sessions were audio-recorded for scoring purposes with the consent of the participant and family member(s). All the subtests of CAT-TR in the Language Battery were completed in one session; approximately took an hour.

Results

The descriptive findings showed that the control participants received the maximum or nearly maximum scores out of all the subtests in the Language Battery. Except for the items with 85% accuracy rate in Subtest *Naming Objects* entitled "saw, rolling pin and parrot", all the other items in the subtests were scored with more than 90% accuracy.

Table 9. CAT-TR performance of PWA and control participants.

Subtests		Total Score	*M (SD)* PWA	*M (SD)* Healthy	U	p
Part 1: **Language Comprehension**						
ST 7	Comprehension of Spoken Words	30	22.15 (8.05)	30.00 (0)	70.00	.000**
ST 8	Comprehension of Written Words	30	19.70 (9.20)	29.90 (0.44)	54.00	.000**
ST 9	Comprehension of Spoken Sentence	32	16.35 (9.22)	31.60 (0.82)	14.00	.000**
ST 10	Comprehension of Written Sentences	32	11.45 (8.92)	31.60 (0.82)	0.00	.000**
ST 11	Comprehension of Spoken Paragraphs	4	2.25 (1.25)	3.80 (0.41)	56.00	.000**
Part 2: **Language Production**						
ST 12	Repetition of Words	32	14.75(12.48)	32.00 (0)	20.00	.000**
ST 13	Repetition of Complex Words	6	2.60 (2.60)	6.00 (0)	60.00	.000**
ST 14	Repetition of Nonwords	10	3.05 (2.99)	10.00 (0)	10.00	.000**
ST 15	Repetition of Digit Strings	14	4.80 (3.91)	12.90 (1.37)	14.50	.000**
ST 16	Repetition of Sentence	12	3.30 (4.41)	12.00 (0)	20.00	.000**
ST 17	Naming Objects	48	18.65 (17.53)	44.55 (3.37)	29.00	.000**
ST 18	Naming Actions	10	4.95 (4.61)	10.00 (0)	60.00	.000**
ST 20	Readings Words	48	16.90 (16.91)	48.00 (0)	20.00	.000**
ST 21	Reading Complex Words	6	1.20 (1.96)	6.00 (0)	10.00	.000**
ST 22	Reading Function Words	6	2.60 (2.68)	6.00 (0)	60.00	.000**
ST 23	Reading Nonwords	6	2.85 (3.58)	6.00 (0)	90.00	.001*
ST 24	Writing: Copying	27	17.70 (11.58)	27.00 (0)	80.00	.000**
ST 25	Writing Picture Names	21	7.00 (8.61)	20.2 (1.43)	37.00	.000**
ST 26	Writing to Dictation	28	10.15 (10.60)	28.00 (0)	10.00	.000**

*$p < .01$, **$p < .001$

As shown in Table 9, the PWA performed more poorly than the controls. The performances of PWA and the control group were compared by Mann-Whitney U test as the data did not exhibit a normal distribution. The mean values of the subtests in the Language Comprehension part ranged from 2.25 to 22.15 in PWA and 3.80 to 31.60 in the control group. The mean values in the Language Production part ranged from 1.20 to 18.65 in PWA and 6.00 to 44.55 in the control group. Significant differences were observed among all the subtests in the Language Battery between the groups.

Discussion

The pilot study of CAT-TR Language Battery focused on two different aims. The first aim was to determine whether control participants responded correctly to each of the items in this part. It was seen that the mean values of all the subtests were very high. This implied that the participants did not experience any difficulty while performing the test. The presentation of the instructions for each subtest was eligible and clear as far as the feedbacks of the participants were concerned.

The second aim was to implement the CAT-TR Language Battery to Turkish-speaking PWA and compare the performances of PWA with the control participants. The fact that control group participants scored significantly better than PWA is not surprising in the light of aphasiology literature (Ivanova & Hallowell, 2013).

CAT has been adapted to four languages so far including Arabic, Dutch, Danish, and Croatian (Abou El-Ella et al., 2013; Kuvač Kraljevič et al., 2020; Swinburn et al., 2014; Swinburn et al., 2014). Due to the fact that the Dutch and Danish versions of CAT were published in their native languages; the remaining studies were considered. In the case of the adaptation of CAT into Arabic, the performance of PWA was found to be significantly lower than control group participants (Abou El-Ella et al., 2013). Similarly, the CAT-HR (Croatian version) scores among PWA were reported to be "generally" lower than the control. There was an overlap of scores between PWA (indicating performance within the "normal" range) and controls (with lower achievement levels). The mentioned performance level was the highest for "*Comprehension of Spoken Paragraphs*" and the lowest for "*Naming Objects and Actions*". Moreover, the performance on one modality (such as *Naming*, etc.) was found to be significantly correlated with the performance of the remaining modalities (including *Spoken and Written Language Comprehension, Repetition, Reading, Writing, Spoken and Written Picture Description*). This implied that aphasia held an impact on language abilities on a general basis (Kuvač Kraljevič et al., 2020).

Items in the CAT-TR Language Battery were controlled for imageability, familiarity, and name agreement based on reported stimuli norming studies 1 and 2. Pilot results show that the current adaptation is adequate and no further changes are indicated at this time.

5. Conclusion

In conclusion, this research reported the findings of three different studies. Initially, the imageability and familiarity ratings of 236 words and name agreement values of 244 pictures were identified for the subtests in the Language Battery. This fulfilled the need for a set of appropriate stimuli to form the Language Battery based on the psycholinguistic

variables. Moreover, this has strong implications for future studies and clinical practice. These items could assist the clinicians in preparing their therapy materials for acquired language disorders. Secondly, the pilot studies were conducted by utilizing the final versions of Cognitive Screen and Language Battery among Turkish-speaking controls and PWA. Special attention was given to whether the instructions and items were easy to comprehend. Additional considerations included whether the duration of the test was challenging for the participants and the fonts were legible. Furthermore, the finding that there was a significant difference between the performances of controls and PWA supports the feasibility of the test with Turkish speakers. In both sections, accuracy rates of each item for the control groups results were 85% and above. This confirmed that culturally and linguistically appropriate stimuli were selected. Future studies will explore the validity and reliability values of these two sections; namely, the Cognitive Screen and the Language Battery of CAT-TR.

Note

1. The adaptation process reported in this study did not include the AIQ-21 as this questionnaire was already adapted and studied with Turkish-speaking PWA (see Yaşar et al., 2021).

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