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OXFORD

The TDQ-60 Tr—a Picture-Naming Test to Assess Anomia in Turkish Adults and the Elderly: Normative Data and Validation Study in Alzheimer's Disease and Mild Cognitive Impairment

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ABSTRACT

Objective: Anomia is defined by difficulty in retrieving content words like nouns and verbs from long-term memory, independent of any impairments related to articulatory movements or motor speech execution. The tools for measuring picture naming, the conventional method for assessing anomia, are very limited in Turkey. The aim of this study was to adapt the Test de Dénomination de Québec—60 images/Quebec picture-naming test—60 pictures (TDQ-60), a color picture-naming test for adults and the elderly into Turkish, establish its validity, and develop normative data adapted to the Turkish population to address this gap.

Method: We conducted three separate studies. The objective of Study 1 was to culturally adapt the *Test de Dénomination de Québec—60 images*. In Study 2, we developed normative data for the TDQ-60 Tr adapted to the adult and elderly population in Turkey based on the performance of 414 community residents aged 18 years and older. In Study 3, the known-group validity, the convergent validity, and the test–retest validity of the TDQ-60 Tr were determined.

Results: The results show that the TDQ-60 Tr is reliable in distinguishing participants with Alzheimer's disease and mild cognitive impairment from healthy participants. The TDQ-60 Tr measures the same cognitive construct as the Boston Naming Test and also has a high test–retest reliability.

Conclusions: In summary, the TDQ-60 Tr is a valid and reliable instrument for assessing naming abilities in adults and the elderly. The results of this study have significant implications for the assessment of naming ability in Turkish-speaking patients. Our work serves as a crucial connection to address the lack of tools for diagnosing anomia in Turkey.

Keywords: Anomia; Naming; Aphasia; Normative data; Test validity

INTRODUCTION

Anomia, which refers to the inability to retrieve content words such as nouns and verbs from long-term memory independently of impairments in motor speech execution (Macoir & Lavoie, 2021), is recognized as a common characteristic of post-stroke aphasia (Laine & Martin, 2006), Alzheimer's disease (AD) (Moayedfar et al., 2019), primary progressive aphasia (Gorno-Tempini et al., 2011), and other major neurological diseases (Bouzigues et al., 2022). Anomia is manifested by difficulties in the spontaneous production of words during oral or written communication and in tasks that require the naming of specific stimuli (Cuetos et al., 2005; Macoir & Lavoie, 2021), such as picture-naming tests.

Naming is an intricate cognitive process that is integrated into many theories of speech and language processing (Johnson et al., 1996). Picture naming tasks have frequently been employed to investigate lexical access and word formation. These tasks allow these processes to be studied in real time (Bates et al., 2003). During the picture-naming task, the subject is presented with a picture and is required to promptly verbalize the first word that comes to mind. Picture naming is a seemingly straightforward ability, but it involves several intricate cognitive processes

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such as conceptual preparation, lexical selection, morphological and phonological encoding, phonetic encoding, and articulation (Levelt, 1999, 2001).

Our brain goes through a sequence of distinct but interconnected processes to name things, starting with seeing and recognizing a familiar input, activating semantic information about it, accessing a phonological representation, and finally producing its name. Various neuropathological causes, whether gradual or acute, can disrupt these stages and impair a patient's ability to name things. The characteristics of these naming problems could provide clinicians with valuable insights into understanding the underlying causes of such alterations (Gleichgerrcht et al., 2015). In fact, anomia may result from different functional localizations. First, anomia can arise either from the loss of semantic representations or from problems in retrieving these representations. Disruptions at this level lead to semantically based anomia (Maher & Raymer, 2004). Lexical-based anomia refers to the impairment resulting from a disruption in the activation of phonological word representations (Best & Nickels, 2000). In many cases, anomia arises from a combination of deficits that affect both the conceptual-semantic and lexical levels (Macoir & Lavoie, 2021). Category-specific anomia has been observed in cases of color name disorder (color anomia) typically resulting from occipital lesions, in finger naming in Gerstmann syndrome (Ardila, 2020), and anomia for given semantic categories of objects (Gainotti, 2000). A typical dissociation that is frequently observed is the impairment in naming animals, vegetables, and fruits, while the ability to name vehicles and tools is retained (Warrington & Shalice, 1984). Additional categorizations of anomia include difficulties in retrieving words caused by the disconnection of brain structures, non-aphasic misnaming, and psychogenic misnaming (Grossman, 2014).

From a clinical standpoint, determining the functional origin of the surface symptoms of anomia is crucial for establishing effective treatment goals in rehabilitation. Consequently, a qualitative analysis of errors in picture-naming tasks provides valuable insights. The nature of these errors is linked to the specific level of production that is impaired. Three primary types of errors can be observed in picture naming: omission errors, verbal paraphasias, and non-verbal paraphasias (Pillon, 2014; Whitworth et al., 2014). Omission errors occur when the semantic or lexical representations are damaged or when there are difficulties in activating them, resulting in no response. Verbal paraphasias can manifest themselves either as semantic or formal errors. Semantic verbal paraphasias (e.g., camel → zebra) can occur due to a semantic impairment or a functional deficit that specifically affects the stage of selecting appropriate words. Neurological damage disrupts the activation of the representation associated with the intended concept so that a partially active, semantically related representation in the group is selected instead, resulting in a semantic error. Formal paraphasias (e.g., camel → chapel) occur when the process of word choice is impaired and can be understood as the result of feedback from the level of sound production to the level of word choice. In these cases, a neurological impairment hinders the activation of the lexical representation associated with the concept. However, all the representations that share phonemes with the intended word are more strongly activated due to feedback from the phonological level. Consequently, a lexical representation that is phonologically related is chosen, resulting in a formal error. Finally, phonemic paraphasias (e.g., camel → /kamul/) occur when there are difficulties in activating the correct phonological form for a particular word.

In AD, there is controversy regarding the cause of anomia. Some researchers argue that AD is characterized by a disconnection disease marked by compromised lexical and/or visual access to preserved semantic representations (Bayles & Kim, 2003; Bayles & Tomoeda, 1983; Ober & Shenaut, 1999). For instance, AD patients have been observed to exhibit "access-like" characteristics, including preserved semantic priming (Nakamura et al., 2000; Rogers & Friedman, 2008) and the facilitative effects of cueing when encountering word finding or serial recall difficulties (Balthazar et al., 2008; Kuslansky et al., 2002). Others argue that AD leads to the deterioration of core semantic representations (Chertkow & Bub, 1990; Devlin et al., 1998; Gonnerman et al., 1997; Hornberger et al., 2009). From the neurobehavioral perspective, the hypothesis that AD leads to a dual impairment of process and content in semantic memory is strongly supported (Rogers & Friedman, 2008).

Various tools are used to evaluate naming. However, there are only a limited number of tools that measure picture-naming skills in Turkish (Özdemir et al., 2022; Soylu & Cangöz, 2018). One of these tools, the Comprehensive Aphasia Battery (Özdemir et al., 2022), includes object-naming sections with 24 items and action-naming sections with 5 items. The normative data of this test battery were based on the performance of 200 Turkish speakers, but 18- to 44-year-olds were underrepresented in the sample ($n = 42$; 21%). The Boston Naming Test (BNT), which was developed in English by Kaplan and colleagues (1983), was adapted to the Turkish language by replacing 29 of the 60 items with new items (Soylu & Cangöz, 2018). However, no validity study of this Turkish version of the BNT was conducted and the norms only applied to people aged 60 and over. Therefore, a picture-naming test that is linguistically and culturally adapted for the Turkish-speaking population, with psychometric validity measures and well-distributed normative data, is required.

Psycholinguistic properties of items play a crucial role in examinations and evaluations used to diagnose language impairments. The Test de Dénomination de Québec-60 (Macoir et al., 2018) is a picture-naming test in which the authors determined the psycholinguistic properties of the items known to influence naming abilities. Therefore, the 30 pictures depicting natural and 30 man-made concepts were matched for concept familiarity, word familiarity, word frequency, age of acquisition, word length, and visual complexity. The TDQ-60 was developed as part of a comprehensive approach that includes the determination of translational validity. Its content validity was established based on the scientific literature on acquired anomia. The equal distribution of natural and man-made concepts in the test is also very interesting and useful for identifying category-specific anomia. Finally, one of the advantages of the TDQ-60 is its use of color pictures, which are named more quickly and effectively than black and white images (Bramão et al., 2011; Zannino et al., 2010). The inherent naturalness of color pictures also reduces the impact of related perceptual deficits, facilitating improved identification of lexical-semantic deficits.

In the original study by Macoir and coworkers (2018), data were collected from both healthy controls (HCs) and participants with the semantic variant of primary progressive aphasia to establish the known-discriminant validity of the TDQ-60, while its convergent validity was established with the Boston Naming Test (Macoir et al., 2018). Since its publication, the TDQ-60 has been used many times in clinical studies (Bouvier et al., 2022; Masson-Trottier et al., 2022) and is now widely used in clinical settings in Quebec and French Canada.

The TDQ-60 has several advantages, such as its colorful design, which encourages participants to be more motivated to answer. It is also crucial to have an additional option to evaluate naming.

This study aims to adapt the TDQ-60 into Turkish, to develop normative data adapted to the Turkish population and to determine its validity in Turkish-speaking patients. The study (Project 2015-KAEK-80-23-24) received approval from the Ethics Committee of Biruni University. All procedures adhered to the ethical standards set by the institution's committee and the Helsinki Declaration of 1964, and written informed consent was obtained from all participants.

STUDY 1. TURKISH ADAPTATION OF THE TDQ-60

Presentation of the Test

The TDQ-60 is a color picture-naming test for the identification of acquired anomia in adults and the elderly. The test comprised 30 pictures that corresponded to natural concepts (living things: animals = 16; fruits and vegetables = 10; body parts = 3; nature = 1) and 30 pictures corresponding to man-made concepts (non-living things: tools = 6; kitchen utensils = 5; musical instruments = 4; vehicles = 7; clothing = 8). Natural and man-made concepts and their corresponding names were matched according to concept familiarity, word familiarity, word frequency, age of acquisition, word length in phonemes, and visual complexity (Macoir et al., 2018). The test is implemented in a PowerPoint or Keynote presentation that can be administered in 10–15 min using a computer or electronic tablet.

Adaptation of TDQ-60 for the Turkish Population

Initially, the researchers translated all the TDQ-60 items into Turkish and subsequently assessed their cultural appropriateness and frequency in Turkish. We requested the assistance of five experienced speech and language pathologists (SLPs) to evaluate the face validity of the test items. For face validity, SLPs were asked to complete a questionnaire on the name and cultural appropriateness of the items. As a result of this questionnaire, the final version of TDQ-60 was created by changing seven items. Table 1 displays the changes made in the original version of the TDQ-60 Tr. These alterations were related to seven specific elements. The words "accordéon" (accordion), "chenille" (caterpillar), "hippocampe" (seahorse), "céleri" (celery), "mitaine" (mitten), "orteil pouce" (thumb), and "mouffette" (skunk) have been replaced by "whistle," "chicken," "corn," "camel," "socks," "ear," and "lion." The corresponding pictures were selected from the same database of Snodgrass and VanderWart (1980) (Snodgrass & Vanderwart, 1980) as in the pictures of the original study. All SLPs reached a consensus on the final version of the test.

STUDY 2. NORMATIVE DATA OF THE TURKISH

The aim of Study 2 was to develop normative data for the TDQ-60 Tr adapted to adult and aged populations from Turkey.

Method

The initial study sample consisted of 423 Turkish-speaking adults aged 18 and older, all residing in the community and in good health. Speech-language pathology students and research assistants in Istanbul recruited healthy adults living in the community through referrals from their acquaintances and Maltepe University, Faculty of Medicine, Department of Neurology in Istanbul, Turkey. Eligibility required participants to: (a) be assessed as healthy by a neurologist, (b) provide informed consent, (c) have adequate sensory abilities to complete tasks, (d) be native Turkish speakers, and (e) have had no head trauma in the past two years. Participants were excluded if their Montreal Cognitive Assessment (Nasreddine et al., 2005) score fell below the cutoffs established by Kaya and associates (2014), which are based on the educational level in Turkey: primary school = 17/30; secondary and high school = 20/30; university = 22/30. Additionally, participants were excluded if their scores on the Detection Test for Language impairments in Adults and the Aged (DTLA-Tr), a rapid language screening tool, were below the cutoffs set by Karalı and colleagues (2024), also according to the Turkish education system: primary school = 76/100; secondary and high school = 82/100; university = 80/100. All participants reported being mentally and physically healthy, with no history of neurological disorders, untreated psychiatric conditions, traumatic brain injury, or unresolved medical issues that could affect cognitive performance.

Material and Procedure

Each participant was tested in a single testing session in a quiet environment, either at home or in a study facility. In addition to the Montreal Cognitive Assessment (MoCA) and the DTLA-Tr, they were administered the TDQ-60 Tr and the Turkish version of the Boston Naming Test—30 items (Soylu & Cangöz, 2018). The BNT was used to determine the convergent validity of the TDQ-60 TR (see Study 3). The TDQ-60 Tr was administered using a PowerPoint presentation, whereas a paper booklet was used for the BNT. Participants were not interrupted during the task, and instructions were repeated when necessary. They were asked to name each of the pictures in the two tests with a single noun after it was presented. Responses were meticulously recorded word for word.

Statistical Analysis

The total score was chosen as the variable of interest for normalization. First, the data distributions of the normative sample were assessed for skewness using the Shapiro–Wilk test and histograms. The TDQ-60 Tr scores exhibited negative skewness, and no transformation could normalize the distribution. As a result, partial Spearman rank correlations were

Table 1. TDQ-60 Tr Item List

Item number	Original version in French	English version	Turkish version		Final Turkish version	Semantic category
1	Accordéon	Accordion	Akordiyon	Changed to	Düdük	Man-made
2	Œil	Eye	Göz		Göz	Biological
3	Cuillère	Spoon	Kaşık		Kaşık	Man-made
4	Écureuil	Squirrel	Sincap		Sincap	Biological
5	Oignon	Onion	Soğan		Soğan	Biological
6	Autobus	Bus	Otobüs		Otobüs	Man-made
7	Avion	Airplane	Uçak		Uçak	Man-made
8	Chenille	Caterpillar	İpek böceği	Changed to	Tavuk	Biological
9	Bouilloire	Kettle	Çaydanlık		Çaydanlık	Man-made
10	Clou	Nail	Çivi		Çivi	Man-made
11	Violon	Violin	Keman		Keman	Man-made
12	Hélicoptère	Helicopter	Helikopter		Helikopter	Man-made
13	Fourmi	Ant	Karınca		Karınca	Biological
14	Moto	Motorcycle	Motosiklet		Motosiklet	Man-made
15	Piano	Piano	Piyano		Piyano	Man-made
16	Citron	Lemon	Limon		Limon	Biological
17	Mouche	Fly	Sinek		Sinek	Biological
18	Vache	Cow	İnek		İnek	Biological
19	Camion	Truck	Kamyon		Kamyon	Man-made
20	Céleri	Celery	Pırasa	Changed to	Mısır	Biological
21	Pomme	Apple	Elma		Elma	Biological
22	Marteau	Hammer	Çekiç		Çekiç	Man-made
23	Hippocampe	Seahorse	Deniz atı	Changed to	Deve	Biological
24	Bicyclette	Bicycle	Bisiklet		Bisiklet	Man-made
25	Orange	Orange	Portakal		Portakal	Biological
26	Cerise	Cherry	Kiraz		Kiraz	Biological
27	Jupe	Skirt	Etek		Etek	Man-made
28	Pantalon	Pants	Pantolon		Pantolon	Man-made
29	Couteau	Knife	Bıçak		Bıçak	Man-made
30	Mitaine	Mitten	Eldiven	Changed to	Çorap	Man-made
31	Orteil pouce	Toe	Ayak parmağı	Changed to	Kulak	Biological
32	Arachide	Peanut	Fıstık		Fıstık	Biological
33	Renard	Fox	Tilki		Tilki	Biological
34	Ours	Bear	Ayı		Ayı	Biological
35	Gilet	Vest	Yelek		Yelek	Man-made
36	Serpent	Snake	Yılan		Yılan	Biological
37	Ananas	Pineapple	Ananas		Ananas	Biological
38	Gant	Glove	Eldiven		Eldiven	Man-made
39	Chandail	Sweater	Kazak		Kazak	Man-made
40	Papillon	Butterfly	Kelebek		Kelebek	Biological
41	Cheval	Horse	At		At	Biological
42	Pinceau	Brush	Fırça		Fırça	Man-made
43	Tasse	Cup	Bardak		Bardak	Man-made
44	Ceinture	Belt	Kemer		Kemer	Man-made
45	Bras	Arm	Kol		Kol	Biological
46	Train	Train	Tren		Tren	Man-made
47	Balai	Broom	Süpürge		Süpürge	Man-made
48	Cravate	Tie	Kravat		Kravat	Man-made
49	Poisson	Fish	Balık		Balık	Biological
50	Mouffette	Skunk	Kokarca	Changed to	Aslan	Biological
51	Guitare	Guitar	Gitar		Gitar	Man-made
52	Tigre	Tiger	Kaplan		Kaplan	Biological
53	Araignée	Spider	Örümcek		Örümcek	Biological
54	Rouleau à pâtisserie	Rolling pin	Merdane		Merdane	Man-made
55	Carotte	Carrot	Havuç		Havuç	Biological
56	Fraise	Strawberry	Çilek		Çilek	Biological
57	Tournevis	Screwdriver	Tornavida		Tornavida	Man-made
58	Nuage	Cloud	Bulut		Bulut	Biological
59	Échelle	Ladder	Merdiven		Merdiven	Man-made
60	Chien	Dog	Köpek		Köpek	Biological

computed to examine the relationship between participants' sociodemographic characteristics (age and educational level) and their TDQ-60 Tr scores. Additionally, the effect of sex on TDQ-60 Tr scores was evaluated using the Mann–Whitney *U* test.

Since skewness does not affect percentiles, they provide valuable insights into how common or unusual a test score is within the normative population (Crawford & Garthwaite, 2009). Therefore, percentile ranks were calculated and categorized based on significant correlations between sociodemographic factors and test scores. In this study, we used the overlapping strata procedure proposed by Pauker (1988) to calculate the percentiles for the total number of responses to the TDQ-60 Tr. In this procedure, overlapping cell norms are established at specific age midpoints so that participants may be included in one or more adjacent cells. Although the midpoint means of these adjacent cells differ, their ranges overlap. This method has the benefit of providing more stable group means compared to stratified norms, which results in smoother transitions between age blocks. Therefore, normative data collected from age groups 18–32, 33–48, 49–64, and 65–81 years were applied to individuals whose ages fell within the ranges of 18–39, 26–55, 42–71, and 58–81 years, respectively. All statistical analyses were conducted using Jamovi 2.5 (The Jamovi Project, 2024), with an alpha level set at 0.05.

RESULTS

A total of nine participants from the initial sample were withdrawn due to scores below the cutoffs in the MoCA ($n = 4$) and/or the DTLA-Tr ($n = 5$). The final normative sample included 414 community-dwelling individuals, consisting of 250 females and 164 males, aged between 18 and 81 years (mean age = 46.3 years; *SD* = 19.2). Their formal education ranged from 8 to 21 years (mean education level = 11.9 years; *SD* = 3.10). All participants exhibited normal cognition, as indicated by their average Turkish MoCA score of 25.8 (*SD* = 3.42), and normal language abilities, as reflected in their average DTLA-Tr score of 96.6 (*SD* = 4.81). Detailed participant characteristics, including age, sex, and educational level, are provided in Table 2.

A comparison between the demographic data from Turkey (Turkish Statistic Institute, 2021) and the current study is illustrated in Table 3. This table shows that participants were evenly distributed across various age groups and educational levels. The participants were distributed across different age groups. However, compared to the demographic data from Turkey, some of the age groups in the study sample were different in percentage.

Table 2 shows that participants were evenly distributed across various age groups and educational levels. Sex, age, and education were identified as demographic variables that could potentially influence test performance. Spearman correlations revealed a significant positive relationship between educational level and TDQ-60 Tr total score ($r = 0.239$, $p < .001$), indicating that individuals with higher levels of education performed better on the test. Conversely, a significant negative correlation was found between age and TDQ-60 Tr score ($r = -0.249$, $p < .001$), suggesting that test performance declines with increasing age.

Table 2. Distribution of participants in the normative sample

Characteristics	***n*** **(%)**
Age (years)	
18–32	124 (29.95)
33–48	94 (22.70)
49–64	107 (25.84)
65–81	89 (21.50)
Women	250 (60.40)
Education (years)	
Primary and middle school (8 years of education)	121 (29.23)
High school (12 years of education)	147 (35.51)
University (15 years of education)	146 (35.27)
Cognitive screening	**Mean (*SD*)**
MoCA score	25.80 (3.42) [Min = 17; Max = 30]
DTLA-Tr score	96.60 (4.81) [Min = 76; Max = 100]
TDQ-60 Tr total score	56.6 (3.55) [Min = 32; Max = 60]

Finally, the Mann–Whitney *U* test, with sex as the independent variable, revealed a significant association with the TDQ-60 Tr total score ($U = 16{,}807$, $p < .01$), indicating that women globally performed better than men on the test. Finally, there were no interaction effects of demographic variables on TDQ-60 Tr scores (Age ∗ Education: $p = .093$; Age ∗ Sex: $p = .205$; Education ∗ Sex: $p = .54$; Age ∗ Education ∗ Sex: $p = .302$).

The overlapping strata procedure was used to calculate the 1st, 2nd, 5th, 8th, 10th, 15th, 25th, 35th, 45th, 50th, 55th, 65th, 75th, 85th, 90th, 95th, 98th, and 99th percentiles for the total number of responses to the TDQ-60 Tr, taking into account age, education level, and sex. Normative data collected from age groups 18–32, 33–48, 49–64, and 65–81 years were applied to individuals whose ages fell within the ranges of 18–39, 26–55, 42–71, and 58–81 years, respectively. With respect to education, the school system in Turkey was considered the most suitable, which led to a division into three levels: middle school (8 years of education), high school (12 years of education), and university (15 years of education).

Following a visual inspection of the box-and-whisker plots, the 8th percentile was chosen as the most reliable cutoff value, in line with the recommendation by Guilmette and coworkers (2020) in their consensus statement from the American Academy of Clinical Neuropsychology. Scores at or below this cutoff are considered to fall below normal performance levels. Table 3 presents the descriptive statistics for the normative data by age, educational level, and sex. Because the cutoff score set at percentile 8 is sometimes similar to percentiles 10 (e.g., men with a high school diploma, aged 18–32 years) and/or 15 (e.g., men with a primary school diploma, aged 33–48 years) in some cells of the percentile table, the clinician had to use the score corresponding to percentile 5 to identify performance below the normal range. Similarly, as the cutoff score set at percentile 8 sometimes similar to percentiles 5 (e.g., men with primary school diploma, aged

Table 3. Comparison of demographic data between the Turkish population (%) and the study sample (number and %)

A. Sex distribution

	Turkey		Study sample ($n = 414$)	
	Males	*Females*	*Males (n = 164, 39.6%)*	*Females (n = 250, 60.4%)*
15–19 years[a]	51.4%	48.6%	13 (52.0%)	12 (48%)
20–24 years	51.1%	48.9%	19 (30.2%)	44 (69.8%)
25–29 years	50.9%	49.1%	10 (35.7%)	18 (64.3%)
30–34 years	50.6%	49.4%	2 (10.5%)	17 (89.5%)
35–39 years	50.5%	49.5%	13 (33.3%)	26 (66.7%)
40–44 years	50.3%	49.7%	8 (34.8%)	15 (65.2%)
45–49 years	50.1%	49.9%	9 (33.3%)	18 (66.7%)
50–54 years	50.5%	49.5%	9 (32.1%)	19 (67.9)
55–59 years	49.6%	50.4%	4 (33.3%)	8 (66.7%)
60–64 years	49.1%	50.9%	29 (47.5%)	32 (52.5%)
65–69 years	47.8%	52.2%	11 (36.7%)	19 (63.3%)
70–74 years	45.1%	54.9%	19 (55.9%)	15 (44.1%)
75–79 years	43.0%	57.0%	18 (72.0%)	7 (28.0%)

B. Distribution by sex and level of schooling (diploma)

	Males	*Females*	*Males (n = 164, 39.6%)*	*Females (n = 250, 60.4%)*
Primary school and middle school	49.4%	50.6%	34 (28.1%)	87 (71.9%)
High school	56.4%	43.6%	64 (43.5%)	83 (56.5%)
University	52.6%	47.4%	65 (44.5%)	81 (55.5%)

[a]For the study sample, 18–19 years [b]For the study sample, 75–81 years

49–64 years) and/or 2 (e.g., women with primary school diploma, aged 49–64 years), the clinician must use the score corresponding to percentile 1 to identify performance below the normal range.

STUDY 3. VALIDITY OF THE TDQ-60 TR

The aim of Study 3 was to determine the known-group validity, convergent validity, and test–retest validity of the TDQ-60 Tr in the Turkish population.

Methods

Known-group validity

To establish known-group validity, we examined whether scores on the TDQ-60 Tr differed among HCs, participants with mild cognitive impairment (MCI), and those with AD. Given the known impairments in semantic processing and lexical access (Duong et al., 2006; Taler & Phillips, 2008), we hypothesized that participants with MCI and AD would perform significantly worse than HCs. The sociodemographic characteristics of the participants across the three groups are detailed in Table 4.

Participants

The MCI group comprised 25 participants diagnosed with MCI according to the clinical criteria outlined by Albert and associates (2011): (a) cognitive concerns reflecting a change in cognition reported by the patient, an informant, or the clinician (i.e., historical or observed evidence of decline over time); (b) objective evidence of impairment (greater than −1.5 standard deviation [*SD*] based on normative data for age, sex, and education) in one or more cognitive domains, including episodic memory; (c) no significant impairment in functional abilities based on clinical consensus and the Alzheimer's Disease Cooperative Study-Activities of Daily Living (ADCS-ADL); and (d) not demented.

The AD group comprised 25 individuals diagnosed with probable AD dementia, as per the current diagnostic criteria (McKhann et al., 2011), confirmed through patients' medical records and history, such as a diagnosis by a medical doctor and/or receiving approved pharmacological dementia treatment. The included participants with probable AD dementia were at the mild stage of the disease. The AD and MCI participants were recruited from Maltepe University, Faculty of Medicine, Department of Neurology in Istanbul, Turkey. They were diagnosed by a neurologist, who is the fourth researcher in this study.

The HC group comprised 25 participants from Study 2 (normative data), who were selected to match the AD and MCI participants on demographic characteristics to avoid bias in these variables. They exhibited good physical and mental health, reported no noteworthy subjective cognitive complaints, and demonstrated general cognitive performance within the normal range on the MoCA test (Nasreddine et al., 2005), based on Turkish normative data (Karalı et al., 2024).

The exclusion criteria for all participants were: (a) a history of moderate or severe traumatic brain injury, (b) a history of cerebrovascular disease, (c) a history of delirium within the past 6 months, (d) a history of intracranial surgery, (e) a history of neurological disorders of cerebral origin not investigated in the study, (f) a history of encephalitis or bacterial meningitis, (g) unstable metabolic or medical conditions (e.g., untreated hypothyroidism or diabetes), (h) an active and unstable psychiatric syndrome, (i) alcoholism or substance abuse,

Table 4. Descriptive statistics (mean and standard deviation) of the participants for the normative study as a function of age, sex, and educational level

Sex	**A) Men**											
Age	**18–32**			**33–48**			**49–64**			**65–81**		
Education	**Primary Sc.**	**High Sc.**	**University**	**Primary Sc.**	**High Sc.**	**University**	**Primary Sc.**	**High Sc.**	**University**	**Primary Sc.**	**High Sc.**	**University**
Mean score (SD)	55.5 (4.10)	57.4 (3.92)	56.3 (4.93)	55.6 (3.12)	57.6 (2.45)	57.3 (4.79)	54.5 (3.69)	55.7 (2.92)	56.9 (2.56)	51.6 (3.97)	54.8 (4.63)	56.1 (2.74)
Percentiles												
1	46	44	41	49	53	41	48	50	51	46	40	50
2	47	47	43	46	53	45	48	50	51	46	44	51
5	48	54	52	51	53	54	49	50	52	47	50	51
8 (cutoff)	**49**	**55**	**54**	**53**	**53**	**55**	**49**	**52**	**53**	**47**	**50**	**52**
10	50	55	54	53	53	56	49	52	53	47	51	52
15	52	56	55	53	55	56	50	53	54	48	51	53
25	54	57	56	53	57	57	52	53	56	49	53	55
35	56	58	56	54	58	58	53	55	56	50	55	56
45	56	58	58	56	58	59	54	55	57	51	55	56
50	57	58	58	56	58	59	55	56	57	51	55	56
55	57	59	58	56	59	59	56	57	58	51	56	57
65	57	59	58	57	59	59	57	57	58	52	57	57
75	58	59	59	58	59	59	58	58	59	54	58	58
85	58	60	59	59	60	60	58	59	59	57	59	59
90	60	60	59	60	60	60	58	59	60	58	59	60
95	60	60	60	60	60	60	59	59	60	58	59	60
98	60	60	60	60	60	60	59	60	60	58	59	60
99	60	60	60	60	60	60	60	60	60	60	60	60
Sex	**B) Women**											
Age	**18–32**			**33–48**			**49–64**			**65–81**		
Education	**Primary Sc.**	**High Sc.**	**University**	**Primary Sc.**	**High Sc.**	**University**	**Primary Sc.**	**High Sc.**	**University**	**Primary Sc.**	**High Sc.**	**University**
Mean score (SD)	56.8 (2.97)	57.9 (1.63)	57.5 (3.97)	56.3 (2.84)	57.9 (1.76)	57.2 (4.46)	55.3 (3.43)	57.2 (2.45)	58.0 (2.24)	55.1 (3.91)	56.3 (3.03)	57.8 (2.80)
Percentiles												
1	48	54	43	49	53	40	48	51	52	48	49	51
2	50	54	54	50	54	49	49	52	53	48	50	52
5	52	56	54	52	54	55	49	53	55	49	52	53
8 (cutoff)	**53**	**56**	**55**	**53**	**55**	**55**	**49**	**53**	**55**	**49**	**53**	**55**
10	53	56	55	53	56	55	50	54	55	49	53	55
15	55	56	56	54	56	56	52	55	56	50	53	55
25	55	57	57	55	57	57	54	56	58	52	54	57
35	57	58	58	55	58	57	54	57	58	54	55	58
45	57	58	58	56	58	58	55	57	58	56	56	59
50	57	58	58	57	58	58	56	58	59	56	57	59
55	58	58	58	57	58	58	56	58	59	57	57	59
65	58	59	59	58	59	59	57	59	59	58	58	59
75	59	59	59	58	59	59	58	59	60	58	59	60
85	60	59	60	59	59	60	59	60	60	59	59	60
90	60	60	60	60	60	60	59	60	60	59	60	60
95	60	60	60	60	60	60	60	60	60	60	60	60
99	60	60	60	60	60	60	60	60	60	60	60	60
99	60	60	60	60	60	60	60	60	60	60	60	60

Notes: ***SD*** = standard deviation; **Age**: age in years; **Cutoff**: suggested cutoff score calculated as the 8th percentile (score equal to or below it is under normal performance limits).

(j) uncorrected vision or hearing impairments, (k) a cancer treatment in the past 12 months, (l) a general anesthesia in the past 6 months, (m) a history of psychotic symptoms or manic episodes, and (n) inability of the participant to provide consent due to inaptitude.

Material and procedure

Each participant underwent testing in a single session in a quiet environment, which took place either at their home or in a study facility. The cognitive status of all participants in the known-group discriminant validity was determined using the MoCA

Table 5. Comparison of HC, MCI, and AD participants on sociodemographic variables and TDQ-60 Tr

Characteristics	HC ($n = 25$)	MCI ($n = 25$)	AD ($n = 25$)	p	Effect size
Age, mean (SD)	70.6 (5.16)	70.4 (6.84)	71.1 (5.11)	.867	$\varepsilon^2 = 0.0038$
Education, mean (SD)	10.8 (2.93)	12.8 (2.57)	10.6 (2.83)	.014	$\varepsilon^2 = 0.116$
Female, n (%)	17 (68.00)	10 (40.00)	15 (60.00)	.12	
MoCA, mean (SD)	24.1 (3.35)	18.8 (1.74)	13.9 (2.96)	<.001[a,b,c]	$n_p^2 = 0.702$
DTLA-Tr, mean (SD)	95.1 (5.16)	89.2 (7.17)	76.7 (14.40)	<.001[a,b,c]	$\varepsilon^2 = 0.42$
TDQ-60 Tr total score	56.3 (3.13)	52.4 (4.46)	48.8 (6.46)	<.001[a,b,c]	$n_p^2 = 0.292$
• Natural concepts	28.0 (2.11)	25.7 (2.85)	24.1 (4.01)	<.001[a,b]	$n_p^2 = 0.220$
• Man-made concepts	28.2 (1.59)	26.7 (1.97)	24.6 (2.97)	<.001[b,c]	$n_p^2 = 0.309$

HC = healthy controls; MCI = mild cognitive impairment; AD = Alzheimer's disease. [a]Symbols for significant post hoc group differences: HC versus MCI. [b]Symbols for significant post hoc group differences: HC versus AD. [c]Symbols for significant post hoc group differences: MCI versus AD.

and the DTLA-Tr. They were then administered the TDQ-60 Tr using the same procedure as in the study on the normative data.

Statistical analyses

First, to reduce the risk of selection bias, the performance of the 25 healthy participants in the sample for the known discriminant validity in the MoCA and DTLA-Tr was compared with the performance of the 150 healthy participants in the normative sample of the same age range. As the scores in the two tests were not normally distributed, the comparison was carried out using Mann–Whitney U tests. Chi-square analysis was used to assess differences in sex distribution between the three groups. Kruskal–Wallis tests were used to compare the groups in terms of age, educational level, and DTLA-Tr score. Analysis of variance (ANOVA) was used to compare performance on the MoCA and the TDQ-60 Tr (total score and scores for natural and man-made concepts). Pairwise comparisons were conducted using Dwass–Steel–Critchlow–Fligner post hoc tests or paired t-tests with a Bonferroni correction. Effect sizes were reported as partial eta squared (η^2) and interpreted based on Cohen (1988), where values from 0.01 to 0.06 indicate a small effect, values from 0.06 to 0.14 indicate a moderate effect, and values above 0.14 indicate a strong effect. All statistical analyses were carried out using Jamovi 2.5. (The Jamovi Project, 2024), with the alpha level set at 0.05.

RESULTS

The performance of the 25 healthy participants in the sample for the known discriminant validity (mean age = 70.6, SD = 5.16) in the MoCA and DTLA-Tr was statistically equivalent (MoCA: $U = 1{,}761$, $p = .63$; DTLA-Tr: $U = 1{,}846$, $p = .90$) to the performance of the 150 healthy participants in the normative sample (mean age = 67.7, $SD = 6.13$) of the same age range, indicating no apparent selection bias. As shown in Table 5, the three groups were statistically equivalent in terms of sex ($\chi^2 = 4.21$, $df = 2$, $p = .12$) and in terms of age, $\chi^2 = 0.285$, $df = 2$, $p = .87$. However, the three groups differed in terms of educational level $\chi^2 = 8.58$, $df = 2$, $p = .014$. The Dwass–Steel–Critchlow–Fligner post hoc tests showed that the age of the AD participants was equivalent to that of the HCs, $W = 0.37$, $p = .96$, whereas they were statistically older than the MCI participants, $W = 3.75$, $p = .022$. Finally, the HCs were also statistically older than the MCI participants, $W = 3.39$, $p = .044$.

As expected, the three groups were statistically different with respect to general cognition measured with the MoCA, $F(2, 72) = 84.7$, $p < .001$. Post hoc tests revealed that: (a) the performance of HCs differed significantly from participants with MCI ($p < .001$) and participants with AD ($p < .001$), and (b) the performance of participants with MCI differed significantly from participants with AD ($p < .01$). As also expected, the groups also differed statistically in terms of general language ability as measured by the DTLA-Tr, $F(2, 72) = 23.3$, $p < .001$. Post hoc tests revealed that the performance of the participants with AD was statistically lower than that of HCs ($p < .01$) and that of participants with MCI ($p < .01$), whereas the performance of HCs and participants with MCI was statistically equivalent ($p < .105$).

With respect to the TDQ-60 Tr, the ANOVA revealed a main effect of the group for the total score, $F(2, 72) = 14.8$, $p < .001$. Post hoc tests revealed that the performance of HCs was significantly better than that of the participants with MCI ($p = .019$) and the participants with AD ($p < .001$). Moreover, the performance of participants with MCI was significantly better than that of the participants with AD ($p = .031$). The results by semantic category also revealed main effects of the group for the score on natural concepts, $F(2, 72) = 10.2$, $p < .001$ and on man-made concepts, $F(2, 72) = 16.1$, $p < .001$. For natural concepts, the post hoc tests revealed that: (a) the performance of HCs was significantly better than that of the participants with MCI ($p = .026$) and the participants with AD ($p < .001$), and (b) the performance of participants with MCI was statistically equivalent to that of the participants with AD ($p = .24$). For man-made concepts, the post hoc tests revealed that: (a) the performance of HCs was significantly better than that of the participants with AD ($p < .001$), whereas a trend toward significance was found for the comparison of HCs and MCI participants ($p = .059$), and (b) the performance of participants with MCI was statistically better than that of the participants with AD ($p = .005$).

Convergent Validity

Convergent validity was established through the administration of two picture-naming tests, the TDQ-60 Tr and the 30-item version of the Boston Naming Test (Kaplan et al., 1983; Özdemir et al., 2022; Soylu & Cangöz, 2018). Since both tests involve similar cognitive processes of visual recognition, semantic activation, and lexical access, a positive correlation was expected.

Participants

The two naming tests were administered to the 414 healthy participants in the normative study (see Study 2) and to the 25 participants with MCI and 25 participants with AD of the known-group discriminant validity study.

Statistical analyses

As the data in the two tests were not normally distributed, the relationship between the participants' performance in the two tests was analyzed using Spearman's rank correlation coefficient.

Results

As expected, the TDQ-60 Tr correlated significantly and positively (Speaman's rho $= 0.622$, $p < .001$) with the BNT-30, indicating that the two tests are likely measuring the same cognitive construct.

Test–Retest Reliability

The TDQ-60 Tr was administered twice to a group of healthy participants. The interval between the two separate administrations ranged from 2 weeks to 1 month.

Participants

This procedure was conducted with a group of 34 healthy participants (8 men; 26 women), with a mean age of 36.5 years ($SD = 16.1$), a mean education level of 12.9 years ($SD = 2.98$), a mean MoCA score of 27.2 ($SD = 3.03$), and a mean DTLA-Tr score of 97.2 ($SD = 5.17$). These participants, who were also involved in the normative study (see Study 2), consented to be assessed twice using the same test.

Statistical analyses

The two measures (T1 and T2) were compared using Bland–Altman analysis [39] and the intraclass correlation coefficient (ICC).

Results

Bland–Altman analysis revealed that the 95% limits of agreement for the TDQ-60 Tr ranged from −3.81 [95% CI−4.9, −2.7] to 3.40 [95% CI 2.3, 4.5]. All results fell within this 95% confidence interval. The "bias" or average difference line was close to zero (−0.21 [95% CI−0.85, 0.44]), and the distribution of points around this line was relatively symmetrical, suggesting that participants performed similarly on both measures. There was no statistically significant difference in the performance of the healthy participants between T1 and T2 (T1 mean $= 58.0$, $SD = 1.82$; T2 mean $= 58.2$, $SD = 1.59$; ICC $= 0.426$, $p < .01$), demonstrating that the scores were stable over time.

DISCUSSION

Naming is a crucial aspect of human activity. Anomia, the impairment of naming ability that occurs in various neurological and psychiatric disorders, therefore, significantly impedes language use and functional communication. However, Turkish speech-language pathologists and clinicians do not have culturally appropriate naming tests for their populations. In Turkey, the Comprehensive Aphasia Test-Turkish (CAT-TR) (Özdemir et al., 2022) and the BNT (Kaplan et al., 1983; Özdemir et al., 2022; Soylu & Cangöz, 2018) are among the most frequently used picture-naming tests. As pointed out in the Introduction, the use of these tests in the Turkish population is subject to certain limitations due to linguistic and cultural considerations. In addition, the stimuli in these tests are not controlled for semantic categories, which is essential in order to identify category-specific impairments in naming. The aim of this study was to adapt the TDQ-60 to the Turkish language and to determine its norms, validity, and reliability. The adaptation of the test in Study 1 was made by translating the test items and replacing those that were not culturally adapted to the Turkish population. When interpreting cognitive test results, it is crucial to utilize normative data that consider sociodemographic factors and are tailored to the cultural and linguistic context of the reference population (Mitrushina et al., 2005).

The results from Study 2 provide normative data for the TDQ-60 Tr, based on a sample of 414 healthy, Turkish-speaking adults and elderly individuals living in the community, spanning a broad range of ages and education levels. The extensive participant group is a key strength of this study. The normative data provided in this study take into account the influences of sex, age, and educational level on the ability to name images. These sociodemographic variables are known to influence semantic and lexical processing in picture-naming tasks, to varying degrees across tests and populations. The significant decline in naming abilities with age observed in this study is consistent with a substantial body of evidence (e.g., Connor et al., 2004; Kavé et al., 2010). Several studies also have found that a high score on a picture naming test is associated with a higher level of education (e.g., Patricacou et al., 2007; Randolph et al., 1999). Finally, the relationship between gender or sex and picture-naming performance is less consistent, with some studies indicating an effect of sex (e.g., Mora-Villalobos et al., 2024), whereas others found no such influence (Vicente et al., 2022). In the original Quebec-French version of the test, performance on the TDQ-60 was positively correlated with education and negatively correlated with age, as in the TDQ-60 Tr. However, the score on the TDQ-60 was not significantly correlated with sex.

The results of Study 3 showed that the TDQ-60 Tr can discriminate between the performance of healthy participants and participants with AD and MCI, indicating good known-group discriminant validity. This is an important strength of this study, as no data on the discriminant validity of picture-naming tests were available in Turkey, with the exception of the Comprehensive Aphasia Battery (Özdemir et al., 2022) picture-naming subtest, which was established in participants with aphasia following a stroke.

Word-finding disorders are one of the most common symptoms of brain disorders. There are different types of anomia, depending on the underlying cause. Some people suffer from category-specific anomia (Berndt, 1988), a type of naming disorder that depends on semantic categories of concepts. Although no dissociation by semantic category of concepts was found in Study 3 (known-group discriminant validity), the TDQ-60 Tr may be useful in research and clinical practice to identify category-specific anomia because its items are evenly distributed across natural and man-made concepts. Finally, the results also showed that the TDQ-60 Tr has adequate convergent validity, which was demonstrated with the Turkish version of the BNT, and that the results show good stability over time (test–retest reliability).

This study has a few limitations. First, although the use of an incidental sampling method could be seen as a drawback, the normative data presented in this study are drawn from a large cohort of adults and older adults residing in Turkey. The sample used for the normative data is well distributed in terms of age, sex, and educational level. However, it cannot be completely ruled out that this recruitment method may have led to a bias in the results. Secondly, the TDQ-60 Tr and the BNT-30 were administered to all participants in the same order, which prevents the analysis of possible order effects. Thirdly, patients with MCI displayed language impairment reflected by lower scores on the DTLA-Tr. Thus, they may be in later MCI stages, which could be considered as a limitation. Lastly, participants' age range was between 18 and 81 years. Consequently, underrepresentation of the individuals' age over 81 is another limitation of this study.

In conclusion, the TDQ-60 Tr is a valid and reliable tool in identifying anomia associated with acquired deficits of language in Turkish-speaking adults and older people. Its ease of use makes it a valuable test to complement assessment tools in research and clinical settings in Turkey. As the original TDQ-60 developed in French, the TDQ-60 Tr has the potential to be useful in studies of acquired aphasia (Boucherr et al., (Boucher et al., 2022; Lee & Faroqi-Shah, 2024) or major neurocognitive disorders such as primary progressive aphasia (Auclair-Ouellet et al., 2020), primary progressive apraxia of speech (Bouvier et al., 2022), or posterior cortical atrophy.

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CONFLICT OF INTEREST

None declared.

AUTHOR CONTRIBUTIONS

All authors contributed equally to the study conception and design.

ETHICS APPROVAL

The unpublished data reported in this manuscript were approved by the Ethics Committee of Biruni University (Protocol Number: 2015-KAEK-80-23-24. All procedures complied with the ethical standards established by the institution's ethics committee and the Helsinki Declaration of 1964. We obtained written informed consent from patients and their caregivers.

INFORMED CONSENT

All patients and their caregivers signed written informed consent for the study.

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