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Normative Data for Healthy French-Speaking Persons Aged 80 Years and Older for the DTLA Language Screening Test

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Abstract

The Detection Test for Language Impairments in Adults and the Aged (DTLA) is a quick, sensitive, and standardized screening test designed to assess language disorders in adults and elderly people. The test was specifically developed to detect linguistic impairment associated with major neurocognitive disorders. In 2017, we established normative data on 545 healthy individuals between 50 and 80 years old from four French-speaking countries: Belgium, Canada (Quebec), France, and Switzerland.
Objective: The objective of the present study was to develop norms for the population older than 80 years of age for the DTLA.
Method: We extend the original normative data to include 149 healthy, community-dwelling, French-speaking adults aged 80 years old and older from the same countries.
Results: For the total score of the screening test, we calculated the 5th, 15th, 25th, and 50th percentiles for two education groups. The analyses allowed the identification of cutoff and alert scores based on education level.
Conclusions: With the present study, solid normative data for the DTLA derived from the performance of 694 healthy, community-dwelling adults, and elderly people are now available to clinicians and researchers.

Keywords: Norms/normative studies; Dementia; Language and language disorders; Elderly/geriatrics/aging

Introduction

The entire global population is aging, and there has been a drastic rise in the number and proportion of elderly people. The aging of the population has significant impacts on all sectors of public life, especially the health care delivery system (United Nations, 2020). A large portion of the health care services provided to elderly people addresses neurodegenerative diseases, whose prevalence is directly related to aging. This trend will continue to increase due to the aging of the population, although the prevalence of cognitive impairment and major neurocognitive disorders (MND) also depends on modifiable risk factors (Livingston et al., 2017).

According to the latest edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-5), MND is a broad term that encompasses dementia syndromes (American Psychiatric Association, 2013). MND diagnosis relies on the identification of new-onset cognitive impairment that interferes with the ability to perform everyday activities. This diagnosis is based on

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clinical assessments, including medical records, neurological examinations, laboratory tests, functional evaluation, and cognitive assessments (Hugo & Ganguli, 2014). Primary care physicians commonly use cognitive screening tests, such as the Mini-Mental State Examination (MMSE) (Folstein, Folstein, & McHugh, 1975) and the Montreal Cognitive Assessment (MoCA) (Nasreddine et al., 2005), to help diagnose MNDs. These screening tests have been shown to be efficient in the early diagnosis of mild cognitive impairment (MCI) (Nasreddine et al., 2005), Alzheimer's disease (AD), and other MNDs (Davis et al., 2015; Pinto et al., 2019).

These screening tests involve a few language subtests (e.g., picture naming, repetition); however, these subtests do not cover all the symptoms experienced by people whose main complaints are language related. For example, the first symptoms observed in primary progressive aphasia (PPA) concern language abilities, and they manifest as difficulties in reading, spelling, word finding, comprehension, etc. (Mesulam et al., 2014). Moreover, symptoms vary widely among the three variants of PPA (Gorno-Tempini et al., 2011). For example, apraxia of speech as well as agrammatism in language production may occur in the non-fluent agrammatic variant, impaired confrontation naming and impaired single-word comprehension may occur in the semantic variant, and impaired repetition of long sentences may occur in the logopenic variant (Macoir, Légaré, & Lavoie, 2021).

Furthermore, studies have shown that MND screening tests could be misleading when used to assess people with language problems (Osher, Wicklund, Rademaker, Johnson, & Weintraub, 2007). For example, when using the MoCA, impairment of the recall of words could be due to a semantic or lexical access deficit rather than impairment of episodic memory. Therefore, the risk of misdiagnosis is significant in MND. Conversely, screening tests, such as the MMSE and the MoCA, primarily rely on language abilities and could lead to the overestimation of cognitive impairment in people with language problems (Henry & Grasso, 2018).

MCI, the symptomatic prodromal stage of MNDs, is a heterogeneous condition in which individuals may experience gradual cognitive decline as well as changes in personality and behavior. MCI is typically the first symptomatic stage of MND due to AD but may also be the prodrome of other phenotypes of AD, such as posterior cortical atrophy or the logopenic variant of primary progressive aphasia (Lopez et al., 2006). To address the limitations of existing language disorder screening tests for use in routine office visits, we developed the *Dépistage des troubles du langage chez l'adulte et la personne âgée* (Detection Test for Language Impairment in Adults and the Aged —DTLA). The DTLA is a 5-minute standardized French-language screening test designed to assess language disorders in adults and older adults (Macoir et al., 2017). The DTLA is made of nine tasks: picture naming; word, nonword, and sentence repetition; verbal fluency; spelling to dictation of words and nonwords; spontaneous written sentence production; reading aloud of words and nonwords; sentence-to-picture matching; written word matching; and alpha-span. These tasks can be easily administered by health care professionals. The regional/dialectal differences were considered during the development of the DTLA. The test items as well as their psycholinguistic characteristics were selected, following a comprehensive test development approach, to be adapted to four French-speaking countries: Belgium, Canada (Quebec), France, and Switzerland (Macoir et al., 2017).

The psychometric study of the DTLA showed that it has good convergent and discriminant validity as well as good internal consistency and test–retest reliability (Macoir et al., 2017). Moreover, normative data for the DTLA were established for French-speaking adults from four French-speaking countries: Belgium, Canada (Quebec), France, and Switzerland (Macoir et al., 2017). The DTLA is now widely used, mainly by primary care and specialized clinicians, in these countries for the detection of language impairments associated with MNDs.

The normative data sample comprised healthy individuals between 50 and 80 years old. Of course, MNDs affecting language may occur at a later age. Since the DTLA was published, several clinicians have urged us to develop norms for the population older than 80 years of age. In the present study, we have fulfilled that need by extending the normative data to include French-speaking adults aged 80 years old and older.

Method

Participants

A total of 149 healthy, community-dwelling, French-speaking adults, were recruited in four French-speaking countries (Belgium: $n = 71$, 47.65%; Quebec, Canada: $n = 31$, 20.8%; France: $n = 30$, 20.1%; Switzerland: $n = 17$, 11.4%). All participants had normal age- and education-adjusted MMSE (mean score = 28.07, SD = 1.7) or MoCA (mean score = 25.9, SD = 2.7) scores, which indicate normal cognition. All participants self-reported good mental and physical health (i.e., no history of neurological disease, current untreated psychiatric illness, traumatic brain injury, or untreated medical condition that could interfere with cognitive performance).

Table 1. Descriptive statistics (mean and standard deviation) of the participants as a function of their country, sex, and education level

	Mean age (SD)		Education (SD)	
	Men	Women	Men	Women
Belgium ($n = 71$)	83.23 (3.29)	84.78 (4.18)	12.74 (4.24)	11.72 (3.49)
Canada (Quebec) ($n = 31$)	82.57 (2.79)	83.59 (4.3)	13.92 (6.61)	13.94 (2.38)
France ($n = 30$)	82.29 (3.41)	82.31 (1.85)	9.71 (3.07)	9.44 (2.34)
Switzerland ($n = 17$)	87.2 (3.26)	86 (3.85)	13.8 (4.21)	12.75 (3.49)
Total/sex	83.47 (3.51)	84.14 (3.93)	12.51 (4.73)	11.77 (3.33)
Total ($n = 149$)	83.81 (3.74)		12.13 (4.07)	

Note: Age: age in years; Education: formal education in years; SD = standard deviation.

The sample was composed of 73 men (49%) and 76 women (51%), aged 80 years old and older (mean age = 83.8 years old, SD = 3.74 years old; range 80–93 years old), with years of formal education varying between 5 and 25 (mean education = 12.13 years, SD = 4.1 years). The participants were recruited by speech-language pathology students through public advertisements and among their relatives. Following previous normative studies by our group, we considered the education systems of the four aforementioned countries. Thus, participants were divided into two education groups: 11 or fewer years of formal education and 12 or more years of formal education (Macoir et al., 2017). Table 1 shows the descriptive statistics of the participants as a function of their country, sex, and education level. The two education groups were matched for age (t (147), $p = .007$) and sex ($\chi 2$ (1) = 0.053, $p = .817$). The study was approved by local research ethics boards (#2019-1541), and all participants provided written informed consent to participate in the study. We also ran an ANCOVA with education group (≥11 years and 12+ years) and country (Belgium, France, Canada, and Switzerland) as fixed factors and age as covariate. We found a main effect of education group, $F(1, 137) = 10.86$, $p < .001$). The effect of country was non-significant, $F(3, 137) = 1.66$, $p = .179$. The effect of age did not reach significance, $F(1, 137) = 0.056$, $p = .812$. Critically, the interactions education group x country, $F(3, 137) = 0.70$, $p = .556$, and country x age were not significant, $F(3, 137) = 1.69$, $p = .172$. These results further support the decision of pooling together the data of the four countries and not developing norms that take age into account.

Materials and Procedure

As in the previous normative study of the DTLA (Macoir et al., 2017), all participants were tested individually in a quiet room in their home or a research center. Tasks were administered without any time constraints. All DTLA visual stimuli (pictures, written words) were presented on the test sheet. We used here the same scoring procedure as the one used in the original DTLA publication. All the DTLA subtests have a circumscribed number of items for which a given score is allotted. For the verbal fluency subtest, the number of items (i.e., words) produced varies from one participant to another. Therefore, using the actual number of words produced would have made it impossible to keep the DTLA score at a maximum of 100 points. That is why, based on the distribution of participants' verbal fluency production, we rendered its scoring dichotomous. Thus, for verbal fluency, 15 points are given according to cutoff scores established for 2 education levels: the production of 8 words for individuals who have 11 or fewer years of formal education and the production of 10 words for individuals with 12 or more years of formal education. Written protocols for the tests were followed by research assistants, and the collected data was analyzed.

Data Analysis

As in the previous normative study of the DTLA (Macoir et al., 2017), we then compared the performance of the two groups of education (11 or fewer years of formal education and 12 or more years of formal education) by means of an independent sample t-test and the total DTLA scores as dependent variable. To establish the cutoff scores, we calculated the 5th, 15th, 25th, and 50th DTLA score percentiles for the two education groups. We then visually explored the whisker plots to determine the best cutoff score. We conducted all analyses using Jamovi v.1.8.1 open-source statistical software (The jamovi project, 2021).

Results

The results showed no difference in the total scores according to country (F (3, 53.3) = 1.13, $p = .35$). Consequently, the data for the four countries was pooled for the subsequent analyses. For the fluency task, participants with 12 or more years of formal education produced significantly more words in the fluency task (mean = 11.2, SD = 3.85) as compared to participants with 11 or fewer years of formal education (mean = 8.64, SD = 3.51; t (147) = −4.18, $p < .001$).

Table 2. Descriptive statistics (mean and standard deviation) of the participants as a function of education (≤11 and ≥12 years)

	Education			
	≤11 years		≥12 years	
	Mean	SD	Mean	SD
Age	83.8	3.69	83.8	3.80
Education	8.53	1.39	15.3	2.82
MMSE	27.6	2.03	28.6	1.01
MoCA	25.6	2.95	26.1	2.53
% women	50		52	
N	70		79	
DTLA	88.1	9.82	92.8	7.49
Alert zone	77		84	
Cutoff	67		78	
Total *N*	149			

Note: Age: age in years; Education: formal education in years; MMSE: Mini-Mental State Examination (Folstein, Folstein, & McHugh, 1975) score /30; MoCa: Montreal Cognitive Assessment test (Nasreddine et al., 2005), score /30; % women: percentage of women: *N*: number of participants in the group; DTLA: Detection Test for Language impairments in Adults and Aged people score /100; Alert zone: suggested alert zone calculated as the 15th percentile (a score below it and superior to the cutoff is suspected to be under normal performance); Cutoff: suggested cutoff score calculated as the 5th percentile (a score below it is under normal performance limits); Total *N*: total number of participants in the normative study.

A correlation matrix for age (in years), education (in years), and the DTLA scores was computed. As age increased, DTLA scores were lower ($r(149) = -0.174$, $p = .034$). As education increased, so did the DTLA scores ($r(149) = 0.235$, $p = .004$). No significant association was found between age and education ($r(149) = 0.015$, $p = .858$). For the total DTLA score, the results showed that the performance of participants with 12 or more years of formal education was significantly better (mean = 92.8, SD = 7.49) than that of participants with 11 or fewer years of formal education (mean = 88.1, SD = 9.82; t (147) = −3.30, $p < .001$) (see Table 2). We thus calculated percentiles for each of the two education groups separately.

As in the previous normative study of the DTLA (Macoir et al., 2017), we calculated the 16th percentile as the cutoff score for the fluency task. For participants with 12 or more years of formal education, the 15 points (total score) of the fluency task are granted if they produce 8 or more words; for participants with 11 or fewer years of formal education, the 15 points (total score) of the fluency task are granted if they produce 6 or more words. If these cutoffs are not met, then a score of zero should be given for the fluency task.

For the total score of the DTLA, we calculated the 5th, 15th, 25th, and 50th DTLA score percentiles for the two education groups. In normative studies, the typical criterion to determine an impaired performance is a score below the 5th percentile, which represents the commonly used statistical threshold of 5%. Scores located between the 5th and 10th percentile are often viewed as mildly impaired performances. Thus, the fifth percentile is usually considered to be the most reliable cutoff score (Crawford & Garthwaite, 2009). Therefore, a score equal to or below the cutoff score can be considered below normalcy. Additionally, the 15th percentile was determined to be an alert score. Therefore, a score below the alert score (and above the cutoff score) could be considered borderline performance (Hebben & Milberg, 2009; Macoir et al., 2017). In our sample, only 4 individuals with 11 or fewer years of education (4/70, 5.7%) and 4 individuals with 12 or more years of education (4/79, 5.1%) had DTLA scores below the cutoff score. Moreover, 10 out of the 70 participants with 11 or fewer years of education (14.3%) and 10 out of the 79 participants with 12 or more years of education (12.65%) had DTLA scores below the alert score. In all these cases, further language and cognitive testing should be performed. Table 2 shows the suggested cutoff and alert scores for each education group. For ease of use in clinical and research settings, Table 3 combines the normative data that were developed for individuals between 50 and 80 years old (Macoir et al., 2017) and the normative data from the present study, which were developed for individuals 80 years old and older.

Discussion

An early and reliable cognitive assessment is the first significant step toward the clinical management of MNDs. The DTLA was specifically developed to provide primary care clinicians with a quick, sensitive, and standardized screening test for language disorders in adults and older adults. Easy to use, the DTLA could be selected to detect impairment in people with complaints about language or could be integrated into any screening battery for neurocognitive disorder. An important limitation of our initial study on the validation and normalization of the DTLA (Macoir et al., 2017) was the lack of normative data for people aged 80 years old and older. The present study addressed this limitation.

Table 3. Descriptive statistics (mean and standard deviation) of the 6 groups of participants as a function of age (50–64 years; 65–79 years, and 80 years and over) and education (≤11 and ≥12+ years)

	Age											
	50–64 years				65–79 years				80 years and over			
	Education											
	≥11 years		12+ years		≥11 years		12+ years		≥11 years		12+ years	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Age	57.45	4.42	55.93	3.95	71.74	4.73	70.45	4.83	83.80	3.69	83.80	3.80
Education	9.86	1.77	14.81	2.42	9.40	1.43	15.04	2.47	8.53	1.39	15.3	2.82
% women	59		54		63		53		50		52	
N	126		166		124		129		70		79	
DTLA	93.88	6.99	97.73	4.19	91.58	8.23	96.35	5.88	88.1	9.82	92.8	7.49
Alert	84		94		83		92		77		84	
Cutoff	78		85		75		81		67		78	
Total *N*	694											

Note: For participants with 12 or more years of formal education, the 15 points (total score) of the fluency task are granted if they produce 8 or more words; for participants with 11 or fewer years of formal education, the 15 points (total score) of the fluency task are granted if they produce 6 or more words.

MNDs progress over three distinct stages. The first stage is the preclinical stage; in this stage, individuals can be placed on a continuum ranging from completely asymptomatic to a very subtle decline. The second stage, MCI, is the symptomatic predementia stage of MNDs. MCI is referred to as minor neurocognitive disorder in the DSM-5 and is a heterogeneous condition in which individuals may experience gradual cognitive decline as well as changes in personality and behavior (Petersen, 2016). With respect to language, MCI is mainly characterized by lexical and semantic impairments (Taler & Phillips, 2008). The third stage is MND, which is a common condition that occurs mainly in older people (Smith & Farias, 2018). MNDs are characterized by a significant decline in cognitive functions that is severe enough to impact activities of daily living and social functioning (Unkenstein, 2017). The impairment of cognitive functions in MNDs may affect long- and short-term memory, attention, visual perception, executive functions, motor planning and execution, problem solving, and language. MNDs can be caused by a wide range of pathological entities, among which AD is the most common. Other types of MND include MND due to vascular disease as well as MND in atypical Parkinsonian syndromes, such as MND due to Lewy body disease, corticobasal degeneration, or frontotemporal dementia. While these MND types are commonly associated with episodic memory impairment, they are also characterized by deficits of language that may affect word and sentence comprehension and production abilities (Macoir, Turgeon, & Laforce, 2015). Moreover, language deficits are at the core of the clinical portrait of primary progressive aphasia, a progressive language disorder associated with atrophy of the frontal and temporal regions that typically results from neurodegenerative disease (Gorno-Tempini et al., 2011).

Language screening is therefore of paramount importance in the assessment process of MCI or major neurocognitive impairment. The first step in this process is usually carried out by general practitioners who address the memory- and language-related complaints of their patients. Most language abilities are relatively resistant to cognitive aging, although studies have shown a decline in language abilities sustained by executive functions, such as lexical access (Burke & Shafto, 2004). As with memory complaints, language complaints are very common among older adults (Martins, Mares, & Stilwell, 2012). Moreover, studies have shown the predictive value of language complaints in detecting MCI (Valech et al., 2017). Clinicians usually administer cognitive screening tests, such as the MMSE or the MoCA, when faced with memory complaints. Although these screening tests involve language subtests (e.g., picture naming and verbal fluency in the MoCA and the MMSE), they are not sensitive enough to capture the entire spectrum of language manifestations in MNDs, especially when the core symptoms are language-related, as in primary progressive aphasia. The DTLA was specifically developed to quickly assess language disorders in neurodegenerative diseases. Its use in MCI, in which individuals may experience gradual cognitive decline including language difficulties, could also be of importance, especially in its non-amnestic presentation. Of course, even if a score equal to or below the cutoff score is suggestive of actual impairment, a diagnosis of MND cannot be made. The DTLA is a screening test whose main goal is to determine whether an individual has language impairment, not to make differential diagnosis. The cutoff scores suggested in this study should be used to confirm the presence of a language impairment. In such a case, a thorough clinical exam should be performed to identify the cause of the impaired performance. The suggested alert score should rather be considered as a "red flag" suggesting the need to conduct a more extensive language assessment. The fact that we only included here healthy elderly participants did not allow us to calculate the sensitivity, specificity, and discriminant validity of the DTLA. We did, however, show that the DTLA allows to distinguish normal performance from that of patients with Alzheimer's disease under

80 years of age and in the mild to moderate stages of the disease (Macoir et al., 2017). This limitation should be overcome in future studies that include participants with different cognitive pathologies.

Another limitation of the present study was the use of an incidental sampling method, which could have resulted in selection bias. Although a random sampling method would have been preferable, we believe that the normative data we developed from a large group of participants are quite representative of adults and elderly people of Belgium, Canada (Quebec), France, and Switzerland.

With advancing age, language processing is characterized by progressive decline (Thornton & Light, 2006). The changes are particularly pronounced for language skills supported by attentional abilities and executive functions, such as verbal fluency, naming, and sentence comprehension (Dede & Flax, 2016; Verhaegen & Poncelet, 2013), which are all assessed in the DTLA. It is therefore extremely important to base clinical decisions about the impairment or integrity of language functioning on normative data that is adapted to elderly people. With the present study, we now have solid normative data for the DTLA, derived from the performance of 694 healthy, community-dwelling adults, and elderly people. This large group of participants and the concurrent development of valid norms for the people of four French-speaking countries are the major strengths of this study.

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Declaration of Conflicting Interests

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