clsa élcv
Canadian Longitudinal Study on Aging
Étude longitudinale canadienne sur le vieillissement

Derived Variables – Cognition (COG) Normative Data (Tracking Assessment)

Also see

O'Connell, M. E**.,** Kadlec, H., Maimon, G., Taler, V., Simard, M., Griffith, L., Tuokko, H., Voll, S., Wolfson, C., Kirkland, S., & Raina, P. (2021). Methodological considerations when establishing reliable and valid normative data: Canadian Longitudinal Study on Aging (CLSA) neuropsychological battery. *The Clinical Neuropsychologist*. https://doi.org/10.1080/13854046.2021.1954243

Please cite the above publication when using the normative data.

There are four cognition tests conducted in the Cognition (COG) module: REYI measuring immediate memory recall, REYII measuring delayed memory recall, Animal Fluency (AF) measuring generative verbal fluency, and Mental Alternation Test (MAT) measuring speeded alternation of ascending letters and numbers. AF has two different scoring methods, and thus has two scores associated with it: AF1 and AF2. For each of the 5 test scores, resulting from the four cognition tests, multiple normed scores have been created that adjust for age, sex and education level, each having a different purpose and interpretation. Furthermore, composite scores for the constructs of memory, executive functioning, and overall cognition have been created. Lastly, cognitive impairment indicator variables have been created based on the individual test scores, as well as an overall cognitive impairment indicator variable based on the entire battery of tests.

Comparisons with normative data are necessary for determining whether a person's performance is within the range of healthy cognitive performance. Only once adjustments have been made for covariates known to affect cognition, can a score be determined to fall below the healthy range and cognitive impairment be assessed.

How the normative data were created:

Core to the creation of all normative comparison standards is the initial selection of persons for whom cognitive status is likely within normal limits. For large epidemiological studies, such as the CLSA, this necessitates excluding persons who report medical conditions that could impact cognition. Once a healthy sample has been established, it must then be decided how to correct for covariates or potential confounders associated with healthy aging that are known to impact cognition. In the CLSA, to obtain a healthy sample of participants, we removed all participants who reported neurological conditions that could impact cognition (e.g., diagnosed memory problems, stroke, Parkinson's disease, etc.). Bias in how cognition is measured can occur for groups based on sex and few years of formal education and healthy aging is associated with expected declines in cognition; consequently, the normative data were adjusted to account for age, sex, and education status because these variables can impact how cognition is measured. Furthermore, normative data were created separately for tests completed in French and English because we were not able to demonstrate that cognition was measured equivalently when measured with the English and French translations of these cognitive tests. Only where there is

evidence of similarity in measurement in French and English (i.e., language invariance), do we recommend that data be collapsed across language of administration.

Different types of normed scores:

Normative data used as a comparison standard for an individual's performance results in normed scores that can come in several formats. Normed scores can be expressed as standardized *z*-scores, that have a mean (M) of zero and standard deviation (SD) of 1.0. The *z*-scores can also be converted to standardized T-scores (mean of 50 and standard deviation of 10), standardized "Index scores" (mean of 100 and a standard deviation of 15), or standardized "Scaled Scores" (mean of 10 and standard deviation of 3), by simple linear transformations. Clinicians use the Scaled Scores for many neuropsychological tests (e.g., commonly used intelligence, memory, and executive function batteries) and Index scores for composites, but the standardized *z*-scores might be preferable for researchers. For each of the four cognition tests, we provide standardized *z*-scores and Scaled Scores, as well as normed scores on the original measurement scale.

SUMMARY OF THE DERIVED VARIABLES:

Normed Variables – 15 variables

For each of the five cognition test scores (REYI, REYII, AF1, AF2, and MAT), we provide three normed variables:

1. a Z-score (M = 0, SD = 1.0) – REYI, REYII, AF1, AF2, and MAT (…_NORMED_ZSCORE_TRM)
2. a scaled score (M = 10, SD = 3) – REYI, REYII, AF1, AF2, and MAT (…_NORMED_SM10SD3_TRM)
3. a normed score on the original test scale (M = weighted test score mean, SD = weighted test score SD) – REYI, REYII, AF1, AF2, and MAT (…_NORMED_ORIGSCALE_TRM)

For all normed scores, higher scores indicate better performance.

Composite Variables – 3 variables

1. Memory latent construct score (scaled to M = 100, SD = 15) named COG_CONSTR_MEM_TRM
2. Executive Function latent construct score (scaled to M = 100, SD = 15) named COG_CONSTR_EF_TRM
3. Overall Cognition latent construct score (scaled to M = 100, SD = 15) named COG_CONSTR_OVERALLCOG_TRM

For all latent construct scores, higher scores indicate better functioning.

Cognitive Impairment Indicator (Binary) Variables – 5 variables

1. Cognitive impairment indicator variables, one for each of the cognitive test scores (REYI, REYII, AF2, and MAT) (…_IMP_TRM). Only AF2 impairment is computed because this scoring is closest to versions of AF that is used clinically.
2. Overall cognitive impairment variable, based on the battery of tests, named COG_OVERALL_IMP_TRM

Guide on when to use which derived variable:

Goal	Use Variable Class	Use Derived Variable(s)
To collapse or compare cognition measures across French- and English-speaking samples…	…on individual tests, use **Normed and Standardized Variables**	normed Z Scores (…_NORMED_ZSCORE_TRM), or normed Standard Scaled Scores (..._NORMED_SM10SD3_TRM)
	…on cognitive constructs, use **Latent Construct Variables**	COG_CONSTR_MEM_TRM, COG_CONSTR_EF_TRM, and/or COG_CONSTR_OVERALLCOG_TRM
	…on cognitive impairment on individual tests, use **Cognitive Impairment Indicator (Binary) Variables**	..._IMP_TRM
	…on overall cognitive impairment on the battery of neuropsychological tests, use **Cognitive Impairment Indicator (Binary) Variable**	COG_OVERALL_IMP_TRM
To incorporate the updated sampling weights into the normed scores…	…on individual tests, use the **Normed Variables on the Original Scale**	…_NORMED_ORIGSCALE_TRM
To describe latent constructs of overall cognition or memory and executive functioning…	…use **Latent Construct Variables**	COG_CONSTR_MEM_TRM, COG_CONSTR_EF_TRM, and/or COG_CONSTR_OVERALLCOG_TRM
To assess impairment versus no impairment…	…for each cognitive test, use **Cognitive Impairment Indicator (Binary) Variables**	..._IMP_TRM
	…overall, on battery of all four neuropsychological tests, use the **Overall Cognitive Impairment Indicator (Binary) Variable**	COG_OVERALL_IMP_TRM

A. NORMED STANDARDIZED Z-SCORES

1. REYI z-score

Derived Variable Name: COG_REYI_NORMED_ZSCORE_TRM

Description: This variable is the participant's REYI score, normed for the participant's age, sex and education level and standardized relative to the neurologically healthy norming CLSA subsample. Norming is done separately for tests completed in English and French. These scores are standardized and have a mean of 0 and standard deviation of 1.

Based on: COG_REYI_STARTLANG_TRM, COG_REYI_LANGUAGE_TRM, COG_REYI_SCORE_TRM, SEX_ASK_TRM, ED_UDR04_TRM, AGE_NMBR_TRM

Temporary Variables: Two temporary variables are created. A language variable REYI_LANG is created for coding English or French test administration. The variable COG_REYI_PRED_TRM is the participant's predicted test score based on the participant's language of administration, age, sex and education level. These temporary variables are not included in the CLSA dataset.

Value	Condition(s)	Description
REYI_LANG = 1	COG_REYI_STARTLANG_TRM = 'en' and COG_REYI_LANGUAGE_TRM = 'en'	REYI language of administration is English
REYI_LANG = 2	COG_REYI_STARTLANG_TRM = 'fr' and COG_REYI_LANGUAGE_TRM = 'fr'	REYI language of administration is French
REYI_LANG = blank for missing	Not one of the two conditions above	REYI language is missing or inconsistent
COG_REYI_PRED_TRM = CONSTANT + COEFF * AGE_NMBR_TRM, where CONSTANT and COEFF are estimates from linear regression models obtained from the neuro-healthy norming subsample in each condition	REYI_LANG = (1, 2) and SEX_ASK_TRM = ('M', 'F') and ED_UDR04_TRM = (1, 2, 3, 4)	Regression-based predicted REYI score for English/French men/women with one of 4 levels of education and AGE_NMBR_TRM years old

Derived Variable Specifications:

Value	Condition(s)	Description
(COG_REYI_PRED_TRM – COG_REYI_SCORE_TRM) / SD_RESID, where SD_RESID is the standard deviation of the residual (predicted – observed) scores of the participants in the each condition of the norming subsample	REYI_LANG = (1, 2) and SEX_ASK_TRM = ('M', 'F') and ED_UDR04_TRM = (1, 2, 3, 4)	z-score results from score predicted based on language of administration, age, sex, and education minus observed score divided by standard deviation
(blank for missing)		Score is missing

2. REYII z-score

Derived Variable Name: COG_REYII_NORMED_ZSCORE_TRM

Description: This variable is the participant's REYII score, normed for his/her age, sex and education level relative to the neurologically healthy norming CLSA subsample. Norming is done separately for tests completed in English and French. These scores are standardized and have a mean of 0 and standard deviation of 1.

Based on: COG_REYII_STARTLANG_TRM, COG_REYII_LANGUAGE_TRM, COG_REYII_SCORE_TRM, SEX_ASK_TRM, ED_UDR04_TRM, AGE_NMBR_TRM

Temporary Variables: Two temporary variables are created. A language variable REYII_LANG is created for coding English or French test administration. The variable COG_REYII_PRED_TRM is the participant's predicted test score based on her/his language of administration, age, sex and education level. These variables are not included in the CLSA dataset.

Value	Condition(s)	Description
REYII_LANG = 1	COG_REYII_STARTLANG_TRM = 'en' and COG_REYII_LANGUAGE_TRM = 'en'	REYII language of administration is English
REYII_LANG = 2	COG_REYII_STARTLANG_TRM = 'fr' and COG_REYII_LANGUAGE_TRM = 'fr'	REYII language of administration is French
REYII_LANG = blank for missing	Not one of the two conditions above	REYII language is missing or inconsistent
COG_REYII_PRED_TRM = CONSTANT + COEFF * AGE_NMBR_TRM, where CONSTANT and COEFF are estimates from linear regression models obtained from the neuro-healthy norming subsample in each condition	REYII_LANG = (1, 2) and SEX_ASK_TRM = ('M', 'F') and ED_UDR04_TRM = (1, 2, 3, 4)	Regression-based predicted REYII score for English/French men/women with one of 4 levels of education and AGE_NMBR_TRM years old

Derived Variable Specifications:

Value	Condition(s)	Description
(COG_REYII_PRED_TRM – COG_REYII_SCORE_TRM) / SD_RESID, where SD_RESID is the standard deviation of the residual (predicted –	REYII_LANG = (1, 2) and SEX_ASK_TRM = ('M', 'F') and ED_UDR04_TRM = (1, 2, 3, 4)	z-score results from score predicted based on language of administration, age, sex, and education minus

Value	Condition(s)	Description
observed) scores of the participants in the each condition of the norming subsample		observed score divided by standard deviation
(blank for missing)		Score is missing

3. Animal Fluency-strict (AF1) z-score

Derived Variable Name: COG_AF1_NORMED_ZSCORE_TRM

Description: This variable is the participant's score, normed for his/her age, sex and education level relative to the neurologically healthy norming CLSA subsample. Norming is done separately for tests completed in English and French. These scores are standardized and have a mean of 0 and standard deviation of 1.

Based on: COG_AFT_STARTLANG_TRM, COG_AFT_LANGUAGE_TRM, COG_AF_SCORE_1_TRM, SEX_ASK_TRM, ED_UDR04_TRM, AGE_NMBR_TRM

Temporary Variables: Two temporary variables are created. A language variable AFT_LANG is created for coding English or French test administration. The variable COG_AF1_PRED_TRM is the participant's predicted test score based on her/his language of administration, age, sex and education level. These variables are not included in the CLSA dataset.

Value	Condition(s)	Description
AFT_LANG = 1	COG_AFT_STARTLANG_TRM = 'en' and COG_AFT_LANGUAGE_TRM = 'en'	AFT language of administration is English
AFT_LANG = 2	COG_AFT_STARTLANG_TRM = 'fr' and COG_AFT_LANGUAGE_TRM = 'fr'	AF language of administration is French
AFT_LANG = blank for missing	Not one of the two conditions above	AF language is missing or inconsistent
COG_AF1_PRED_TRM = CONSTANT + COEFF * AGE_NMBR_TRM, where CONSTANT and COEFF are estimates from linear regression models obtained from the neuro-healthy norming subsample in each condition	AFT_LANG = (1, 2) and SEX_ASK_TRM = ('M', 'F') and ED_UDR04_TRM = (1, 2, 3, 4)	Regression-based predicted AF1 score for English/French men/women with one of 4 levels of education and AGE_NMBR_TRM years old

Derived Variable Specifications:

Value	Condition(s)	Description
(COG_AF1_PRED_TRM – COG_AF1_SCORE_TRM) / SD_RESID, where SD_RESID is the standard deviation of the residual (predicted – observed) scores of the participants in the each condition of the norming subsample	AFT_LANG = (1, 2) and SEX_ASK_TRM = ('M', 'F') and ED_UDR04_TRM = (1, 2, 3, 4)	z-score results from score predicted based on language of administration, age, sex, and education minus observed score divided by standard deviation
(blank for missing)		Score is missing

4. Animal Fluency-lenient (AF2) z-score

Derived Variable Name: COG_AF2_NORMED_ZSCORE_TRM

Description: This variable is the participant's score, normed for his/her age, sex and education level relative to the neurologically healthy norming CLSA subsample. Norming is done separately for tests completed in English and French. These scores are standardized and have a mean of 0 and standard deviation of 1.

Based on: COG_AFT_STARTLANG_TRM, COG_AFT_LANGUAGE_TRM, COG_AFT_SCORE_2_TRM, SEX_ASK_TRM, ED_UDR04_TRM, AGE_NMBR_TRM

Temporary Variables: Two temporary variables are created. A language variable AFT_LANG is created for coding English or French test administration. The variable COG_AFT2_PRED_TRM is the participant's predicted test score based on her/his language of administration, age, sex and education level. These variables are not included in the CLSA dataset.

Value	Condition(s)	Description
AFT_LANG = 1	COG_AFT_STARTLANG_TRM = 'en' and COG_AFT_LANGUAGE_TRM = 'en'	AFT language of administration is English
AFT_LANG = 2	COG_AFT_STARTLANG_TRM = 'fr' and COG_AFT_LANGUAGE_TRM = 'fr'	AFT language of administration is French
AFT_LANG = blank for missing	Not one of the two conditions above	AFT language is missing or inconsistent
COG_AF2_PRED_TRM = CONSTANT + COEFF * AGE_NMBR_TRM, where CONSTANT and COEFF are estimates from linear regression models obtained from the neuro-healthy norming subsample in each condition	AFT_LANG = (1, 2) and SEX_ASK_TRM = ('M', 'F') and ED_UDR04_TRM = (1, 2, 3, 4)	Regression-based predicted AF2 score for English/French men /women with one of 4 levels of education and AGE_NMBR_TRM years old

Derived Variable Specifications:

Value	Condition(s)	Description
(COG_AF2_PRED_TRM – COG_AF2_SCORE_TRM) / SD_RESID, where SD_RESID is the standard deviation of the residual (predicted – observed) scores of the participants in the each condition of the norming subsample	AFT_LANG = (1, 2) and SEX_ASK_TRM = ('M', 'F') and ED_UDR04_TRM = (1, 2, 3, 4)	z-score results from score predicted based on language of administration, age, sex, and education minus observed score divided by standard deviation
(blank for missing)		Score is missing

5. Mental Alteration Test (MAT) z-score

Derived Variable Name: COG_MAT_NORMED_ZSCORE_TRM

Description: This variable is the participant's score, normed for his/her age, sex and education level relative to the neurologically healthy norming CLSA subsample. Norming is done separately for tests completed in English and French. These scores are standardized and have a mean of 0 and standard deviation of 1.

Based on: COG_MAT_STARTLANG_TRM, COG_MAT_LANGUAGE_TRM, COG_MAT_SCORE_TRM, SEX_ASK_TRM, ED_UDR04_TRM, AGE_NMBR_TRM

Temporary Variables: Two temporary variables are created. A language variable MAT_LANG is created for coding English or French test administration. The variable COG_MAT_PRED_TRM is the participant's predicted test score based on her/his language of administration, age, sex and education level. These variables are not included in the CLSA dataset.

Value	Condition(s)	Description
MAT_LANG = 1	COG_MAT_STARTLANG_TRM = 'en' and COG_MAT_LANGUAGE_TRM = 'en'	MAT language of administration is English
MAT_LANG = 2	COG_MAT_STARTLANG_TRM = 'fr' and COG_MAT_LANGUAGE_TRM = 'fr'	MAT language of administration is French
MAT_LANG = blank for missing	Not one of the two conditions above	MAT language is missing or inconsistent
COG_MAT_PRED_TRM = CONSTANT + COEFF * AGE_NMBR_TRM, where CONSTANT and COEFF are estimates from	MAT_LANG = (1, 2) and SEX_ASK_TRM = ('M', 'F') and ED_UDR04_TRM = (1, 2, 3, 4)	Regression-based predicted MAT score for English/French men/women with one of 4 levels of education and

Value	Condition(s)	Description
linear regression models obtained from the neuro-healthy norming subsample in each condition		AGE_NMBR_TRM years old

Derived Variable Specifications:

Value	Condition(s)	Description
(COG_MAT_PRED_TRM – COG_MAT_SCORE_TRM) / SD_RESID, where SD_RESID is the standard deviation of the residual (predicted – observed) scores of the participants in the each condition obtained from the norming subsample	MAT_LANG = (1, 2) and SEX_ASK_TRM = ('M', 'F') and ED_UDR04_TRM = (1, 2, 3, 4)	z-score results from score predicted based on language of administration, age, sex, and education minus observed score divided by standard deviation
(blank for missing)		Score is missing

B. NORMED SCALED SCORES (M = 10, SD = 3)

1. REYI Scaled Score

Derived Variable Name: COG_REYI_NORMED_SM10SD3_TRM

Description: This variable is the participant's REYI score, normed for the participant's language of administration, age, sex and education level relative to the neurologically healthy norming CLSA subsample. These scores are standardized and have a mean (M) = 10 and standard deviation (SD) = 3.0. Negative scaled scores are replaced with 0.01.

Based on: COG_REYI_NORMED_ZSCORE_TRM

Derived Variable Specifications:

Value	Condition(s)	Description
(COG_REYI_NORMED_ZSCORE _TRM *3) + 10	COG_REYI_NORMED_ ZSCORE_TRM ≠ missing	Age, sex and education normed score on the REYI, re-scaled to a scale with a M = 10 and SD = 3
(blank for missing)		Score is missing

2. REYII Scaled Score

Derived Variable Name: COG_REYII_NORMED_SM10SD3_TRM

Description: This variable is the participant's REYII score, normed for the participant's language of administration, age, sex and education level relative to the neurologically healthy

norming CLSA subsample. These scores are standardized and have a mean (M) = 10 and standard deviation (SD) = 3.0. Negative scaled scores are replaced with 0.01.

Based on: COG_REYII_NORMED_ZSCORE_TRM

Derived Variable Specifications:

Value	Condition(s)	Description
(COG_REYII_NORMED_ZSCORE_TRM *3) + 10	COG_REYII_NORMED_ZSCORE_TRM ≠ missing	Age, sex and education normed score on the REYII, re-scaled to a scale with a M = 10 and SD = 3
(blank for missing)		Score is missing

3. Animal Fluency-strict (AF1) Scaled Score

Derived Variable Name: COG_AF1_NORMED_SM10SD3_TRM

Description: This variable is the participant's AF1 score, normed for the participant's language of administration, age, sex and education level relative to the neurologically healthy norming CLSA subsample. These scores are standardized and have a mean (M) = 10 and standard deviation (SD) = 3.0. Negative scaled scores are replaced with 0.01.

Based on: COG_AF1_NORMED_ZSCORE_TRM

Derived Variable Specifications:

Value	Condition(s)	Description
(COG_AF1_NORMED_ZSCORE_TRM *3) + 10	COG_AF1_NORMED_ZSCORE_TRM ≠ missing	Age, sex and education normed score on the AF1, re-scaled to a scale with a M = 10 and SD = 3
(blank for missing)		Score is missing

4. Animal Fluency-lenient (AF2) Scaled Score

Derived Variable Name: COG_AF2_NORMED_SM10SD3_TRM

Description: This variable is the participant's AF2 score, normed for the participant's language of administration, age, sex and education level relative to the neurologically healthy norming CLSA subsample. These scores are standardized and have a mean (M) = 10 and standard deviation (SD) = 3.0. Negative scaled scores are replaced with 0.01.

Based on: COG_AF2_NORMED_ZSCORE_TRM

Derived Variable Specifications:

Value	Condition(s)	Description
(COG_AF2_NORMED_ZSCORE_TRM * 3) + 10	COG_AF2_NORMED_ZSCORE_TRM ≠ missing	Age, sex and education normed score on the AF2, re-scaled to a scale with a M = 10 and SD = 3
(blank for missing)		Score is missing

5. MAT Scaled Score

Derived Variable Name: COG_MAT_NORMED_SM10SD3_TRM

Description: This variable is the participant's MAT score, normed for the participant's language of administration, age, sex and education level relative to the neurologically healthy norming CLSA subsample. These scores are standardized and have a mean (M) = 10 and standard deviation (SD) = 3.0. Negative scaled scores are replaced with 0.01.

Based on: COG_MAT_NORMED_ZSCORE_TRM

Derived Variable Specifications:

Value	Condition(s)	Description
COG_MAT_NORMED_ZSCORE_TRM *3) + 10	COG_MAT_NORMED_ZSCORE_TRM ≠ missing	Age, sex and education normed score on the MAT, re-scaled to a scale with a M = 10 and SD = 3
(blank for missing)		Score is missing

C. NORMED SCORES ON THE ORIGINAL TEST SCALE

1. REYI Normed Original Scores

Derived Variable Name: COG_REYI_NORMED_ORIGSCALE_TRM

Description: This variable is the participant's REYI score, normed for the participant's language of administration, age, sex and education level relative to the neurologically healthy norming CLSA subsample. These scores are on the scale of the original REYI scores (ranging from 0 to 15), rescaled using the weighted means and standard deviations (using CLSA_TRM inflation weights v1.2) of the neuro-healthy English/French CLSA norming subsamples.

Based on: REYI_LANG, COG_REYI_NORMED_ZSCORE_TRM

Derived Variable Specifications:

Value	Condition(s)	Description
(COG_REYI_NORMED_ZSCORE_TRM * WTD_SD) + WTD_MEAN, Where WTD_SD is the weighted standard deviation (English = 2.264; French = 2.241) and WTD_MEAN is the weighted mean (English = 6.111;	COG_REYI_NORMED_ZSCORE_TRM ≠ missing and REYI_LANG = (1, 2)	Normed score on the original REYI scale adjusted for sampling weights.

Value	Condition(s)	Description
French = 5.868) of REYI scores of the neuro-healthy CLSA norming subsample		
(blank for missing)		Score is missing

2. REYII Normed Original Scores

Derived Variable Name: COG_REYII_NORMED_ORIGSCALE_TRM

Description: This variable is the participant's REYII score, normed for the participant's language of administration, age, sex and education level relative to the neurologically healthy norming CLSA subsample. These scores are on the scale of the original REYII scores (ranging from 0 to 15), rescaled using the weighted means and standard deviations (using CLSA_TRM inflation weights v1.2) of the neuro-healthy English/French CLSA norming subsamples.

Based on: REYII_LANG, COG_REYII_NORMED_ZSCORE_TRM

Derived Variable Specifications:

Value	Condition(s)	Description
(COG_REYII_NORMED_ZSCORE_TRM * WTD_SD) + WTD_MEAN, Where WTD_SD (English = 2.470 French = 2.557) and WTD_MEAN is the weighted mean (English = 4.487; French = 4.531) of REYII scores of the neuro-healthy CLSA norming subsample	COG_REYII_NORMED_ ZSCORE_TRM ≠ missing and REYII_LANG = (1, 2)	Normed score on the original REYII scale adjusted for sampling weights.
(blank for missing)		Score is missing

3. Animal Fluency-strict (AF1) Normed Original Scores

Derived Variable Name: COG_AF1_NORMED_ORIGSCALE_TRM

Description: This variable is the participant's Animal Fluency-strict (AF1) score, normed for the participant's language of administration, age, sex and education level relative to the neurologically healthy norming CLSA subsample. These scores are on the scale of the original AF1 scores, rescaled using the weighted means and standard deviations (using CLSA_TRM inflation weights v1.2) of the neuro-healthy English/French CLSA norming subsamples.

Based on: AFT_LANG, COG_AF1_NORMED_ZSCORE_TRM

Derived Variable Specifications:

Value	Condition(s)	Description
(COG_AF1_NORMED_ZSCORE_ TRM * WTD_SD) + WTD_MEAN,	COG_AF1_NORMED_ ZSCORE_TRM ≠ missing and AFT_LANG = (1, 2)	Normed score on the original AF1 scale adjusted for sampling weights.

Value	Condition(s)	Description
Where WTD_SD (English = 5.816 French = 5.531) and WTD_MEAN is the weighted mean (English = 20.327; French = 18.599) of AF1 scores of the neuro-healthy CLSA norming subsample		
(blank for missing)		Score is missing

4. Animal Fluency-lenient (AF2) Normed Original Scores

Derived Variable Name: COG_AF2_NORMED_ORIGSCALE_TRM

Description: This variable is the participant's Animal Fluency-lenient (AF2) score, normed for the participant's language of administration, age, sex and education level relative to the neurologically healthy norming CLSA subsample. These scores are on the scale of the original AF2 scores, rescaled using the weighted means and standard deviations (using CLSA_TRM inflation weights v1.2) of the neuro-healthy English/French CLSA norming subsamples.

Based on: AFT_LANG, COG_AF2_NORMED_ZSCORE_TRM

Derived Variable Specifications:

Value	Condition(s)	Description
(COG_AF2_NORMED_ZSCORE_ TRM * WTD_SD) + WTD_MEAN, Where WTD_SD (English = 6.501; French = 6.113) and WTD_MEAN is the weighted mean (English = 21.849; French = 20.101) of AF2 scores of the neuro-healthy CLSA norming subsample	COG_AF2_NORMED_ ZSCORE_TRM ≠ missing and AFT_LANG = (1, 2)	Normed score on the original AF2 scale adjusted for sampling weights.
(blank for missing)		Score is missing

5. MAT Normed Original Scores

Derived Variable Name: COG_MAT_NORMED_ORIGSCALE_TRM

Description: This variable is the participant's MAT score, normed for the participant's language of administration, age, sex and education level relative to the neurologically healthy norming CLSA subsample. These scores are on the scale of the original MAT scores (ranging from 1 to 52), rescaled using the weighted means and standard deviations (using CLSA_TRM inflation weights v1.2) of the neuro-healthy English/French CLSA norming subsamples.

Based on: MAT_LANG, COG_MAT_NORMED_ZSCORE_TRM

Derived Variable Specifications:

Value	Condition(s)	Description
(COG_MAT_NORMED_ZSCORE_ TRM * WTD_SD) + WTD_MEAN, Where WTD_SD (English =8.147; French = 8.007) and WTD_MEAN is the weighted mean (English = 27.499; French = 26.932) of MAT scores of the neuro-healthy CLSA norming subsample	COG_MAT_NORMED_ ZSCORE_TRM ≠ missing and MAT_LANG = (1, 2)	Normed score on the original MAT scale adjusted for sampling weights.
(blank for missing)		Score is missing

D. COMPOSITE VARIABLES

1. Memory Latent Construct Variable

Derived Variable Name: COG_CONSTR_MEM_TRM

Description: A latent construct index variable (M = 100, SD = 15) providing a combined memory score. It is derived from REYI and REYII and is only calculated when both scores are available. It is language invariant.

Based on: COG_REYI_NORMED_SM10SD3_TRM, COG_REYII_NORMED_SM10SD3_TRM

Derived Variable Specifications:

Value	Condition(s)	Description
((COG_REYI_NORMED_SM10SD3_ TRM + COG_REYI_NORMED_SM10SD3_TR M – 20) / 5.64) * 15 + 100	COG_REYI_NORMED_SM10 SD3_TRM ≠ missing and COG_REYII_NORMED_SM1 0SD3_TRM ≠ missing	Score on the memory construct, scaled to M = 100, SD = 15
(blank for missing)		Score is missing

2. Executive Functioning Latent Construct Variable

Derived Variable Name: COG_CONSTR_EF_TRM

Description: A latent construct index variable (M = 100, SD = 15) providing a combined executive functioning score. It is derived from AF2 and MAT and is only calculated when both scores are available. It is language invariant. AF2 is used because this scoring is closest to versions of AF that are used clinically.

Based on: COG_AF2_NORMED_SM10SD3_TRM, COG_MAT_NORMED_SM10SD3_TRM

Derived Variable Specifications:

Value	Condition(s)	Description
((COG_AF2_NORMED_SM10SD3_TRM + COG_MAT_NORMED_SM10SD3_TRM – 20) / 4.85) * 15 + 100	COG_AF2_NORMED_SM10SD3_TRM ≠ missing and COG_MAT_NORMED_SM10SD3_TRM ≠ missing	Score on the executive functioning construct, scaled to M = 100, SD = 15
(blank for missing)		Score is missing

3. Overall Cognition Latent Construct Variable

Derived Variable Name: COG_CONSTR_OVERALLCOG_TRM

Description: A latent construct index variable (M = 100, SD = 15) providing an overall cognition score. It is language invariant. AF2 is used because this scoring is closest to versions of AF that is used clinically.

Based on: COG_REYI_NORMED_SM10SD3_TRM, COG_REYII_NORMED_SM10SD3_TRM, COG_AF2_NORMED_SM10SD3_TRM, COG_MAT_NORMED_SM10SD3_TRM

Derived Variable Specifications:

Value	Condition(s)	Description
((COG_REYI_NORMED_SM10SD3_TRM + COG_REYII_NORMED_SM10SD3_TRM + COG_AF2_NORMED_SM10SD3_TRM + COG_MAT_NORMED_SM10SD3_TRM - 40) / 8.13) * 15 + 100	COG_REYI_NORMED_SM10SD3_TRM ≠ missing and COG_REYII_NORMED_SM10SD3_TRM ≠ missing and COG_AF2_NORMED_SM10SD3_TRM ≠ missing and COG_MAT_NORMED_SM10SD3_TRM ≠ missing	Score on the overall cognition function construct, scaled to M = 100, SD = 15

E. COGNITIVE IMPAIRMENT INDICATOR VARIABLES

1. REYI Cognitive Impairment Variable

Derived Variable Name: COG_REYI_IMP_TRM

Description: A binary-valued variable that indicates whether the participant's normed REYI score falls in the lowest 5% of the neuro-healthy CLSA norming subsample. The cut-off value corresponds to the estimate of the 5th percentile based on the norming subsample. The cut-off value for impairment is language dependent.

Based on: REYI_LANG, COG_REYI_NORMED_ZSCORE_TRM

Derived Variable Specifications:

Value	Condition(s)	Description
0	COG_REYI_NORMED_ZSCORE_TRM ≥ -1.4150 IF REYI_LANG = 1 or COG_REYI_NORMED_ZSCORE_TRM ≥ -1.3889 IF REYI_LANG = 2	Not impaired on REYI
1	COG_REYI_NORMED_ZSCORE_TRM < -1.4150 IF REYI_LANG = 1 or COG_REYI_NORMED_ZSCORE_TRM < -1.3889 IF REYI_LANG = 2	Impaired on REYI (in lowest 5% of healthy participants)
-77771	Missing COG_REYI_NORMED_ZSCORE_TRM	Unable to determine due to missing REYI score

2. REYII Cognitive Impairment Variable

Derived Variable Name: COG_REYII_IMP_TRM

Description: A binary-valued variable that indicates whether the participant's normed REYII score falls in the lowest 5% of the neuro-healthy CLSA norming sub. The cut-off value corresponds to the estimate of the 5th percentile based on the norming subsample. The cut-off value for impairment is language dependent.

Based on: REYII_LANG, COG_REYII_NORMED_ZSCORE_TRM

Derived Variable Specifications:

Value	Condition(s)	Description
0	COG_REYII_NORMED_ZSCORE_TRM ≥ -1.4963 IF REYII_LANG = 1 or COG_REYII_NORMED_ZSCORE_TRM ≥ -1.4448 IF REYII_LANG = 2	Not impaired on REYII
1	COG_REYII_NORMED_ZSCORE_TRM < -1.4963 IF REYII_LANG = 1 or COG_REYII_NORMED_ZSCORE_TRM < -1.4448 IF REYII_LANG = 2	Impaired on REYII (in lowest 5% of healthy participants)
-77771	Missing COG_REYII_NORMED_ZSCORE_TRM	Unable to determine due to missing REYII score

3. Animal Fluency-lenient (AF2) Cognitive Impairment Variable

Derived Variable Name: COG_AF2_IMP_TRM

Description: A binary-valued variable that indicates whether the participant's normed AF2 score falls in the lowest 5% of the neuro-healthy CLSA norming sub. The cut-off value corresponds to the estimate of the 5th percentile based on the norming subsample. The cut-off value for impairment is language dependent.

Based on: AFT_LANG, COG_AF2_NORMED_ZSCORE_TRM

Derived Variable Specifications:

Value	Condition(s)	Description
0	COG_AF2_NORMED_ZSCORE_TRM ≥ -1.5665 IF AFT_LANG = 1 or COG_AF2_NORMED_ZSCORE_TRM ≥ -1.6050 IF AFT_LANG = 2	Not impaired on AF2
1	COG_AF2_NORMED_ZSCORE_TRM < -1.5665 IF AFT_LANG = 1 or COG_AF2_NORMED_ZSCORE_TRM < -1.6050 IF AFT_LANG = 2	Impaired on AF2 (in lowest 5% of healthy participants)
-77771	Missing COG_AF2_NORMED_ZSCORE_TRM	Unable to determine due to missing AF2 score

4. Mental Alteration Test (MAT) Cognitive Impairment Variable

Derived Variable Name: COG_MAT_IMP_TRM

Description: A binary-valued variable that indicates whether the participant's normed MAT score falls in the lowest 5% of the neuro-healthy CLSA norming sub. The cut-off value corresponds to the estimate of the 5th percentile based on the norming subsample. The cut-off value for impairment is language dependent.

Based on: MAT_LANG, COG_MAT_NORMED_ZSCORE_TRM

Derived Variable Specifications:

Value	Condition(s)	Description
0	COG_MAT_NORMED_ZSCORE_TRM ≥ -1.6445 IF MAT_LANG = 1 or COG_MAT_NORMED_ZSCORE_TRM ≥ -1.7688 IF MAT_LANG = 2	Not impaired on MAT
1	COG_MAT_NORMED_ZSCORE_TRM < -1.6445 IF MAT_LANG=1 or COG_MAT_NORMED_ZSCORE_TRM < -1.7688 IF MAT_LANG = 2	Impaired on MAT (in lowest 5% of healthy participants)
-77771	Missing COG_MAT_NORMED_ZSCORE_TRM	Unable to determine due to missing MAT score

5. Overall Cognitive Impairment on Battery of Four Cognitive Tests

Derived Variable Name: COG_OVERALL_IMP_TRM

Description: A binary-valued variable that indicates whether the participant's overall cognitive performance on the battery of four cognitive tests falls in the lowest 5% of the neuro-healthy CLSA norming sub. This can only be calculated when REYI, REYII, AF2, & MAT scores are all available. It is language invariant. AF2 is used because this scoring is closest to versions of AF that are used clinically.

Impairment on the battery of four cognitive test scores is determined based on an algorithm that uses base rates to account for expected low scores (below the 5th percentile) across multiple inter-correlated tests. In our normative CLSA subsample, two or more impaired scores (i.e., below the 5th percentile) was estimated to occur in less than 3.7% (English) and 3.8% (French) participants, but one of four impaired test scores across the battery was relatively common, estimated to occur in 15.9% (English) or 15.7% (French) participants. Given these estimated base rates, two or more impaired scores are rare and suggestive of overall impairment whereas one impaired score is expected and suggestive of no impairment.

Based on: COG_REYI_IMP_TRM, COG_REYII_IMP_TRM, COG_AF2_IMP_TRM, COG_MAT_IMP_TRM

Temporary Variable: The number of tests, out of four, on which the participant's scores fell in the impaired (lowest 5%) range: COG_NMBR_IMP_TRM

Value	Condition(s)	Description	Notes
COG_REYI_IMP_TRM + COG_REYII_IMP_TRM + COG_AF2_IMP_TRM + COG_MAT_IMP_TRM	COG_REYI_IMP_TRM ≠ -77771 and COG_REYII_IMP_TRM ≠ -77771 and COG_AF2_IMP_TRM ≠ -77771 and COG_MAT_IMP_TRM ≠ -77771	Number of cognitive test scores in impaired range	Possible values are 0, 1, 2, 3 or 4
(blank for missing)	If one or more of the four IMP indicators = -77771	Unable to determine due to missing values	

Derived Variable Specifications:

Value	Condition(s)	Description
0	COG_NMBR_IMP_TRM ≤ 1	Not overall cognitively impaired
1	COG_NMBR_IMP_TRM ≥ 2	Overall cognitive impairment is indicated
-77771	COG_NMBR_IMP_TRM = missing	Unable to determine due to missing values