

Derived Variables – Cognition (COG) Normative Data (Comprehensive 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*.
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Please cite the above publication when using the normative data because the above work informed the approach to the Comprehensive normative data.

O’Connell, M. E., Kadlec, H., Taler, V., Gicas, K., Davidson, P., Griffith, L., Wolfson, C., Kirkland, S., & Raina, P. (in preparation). Normative data and factor structure of the neuropsychological battery administered to the Comprehensive Cohort in the Canadian Longitudinal Study on Aging (CLSA)

There are eight cognition tasks in the Cognition (COG) module that provide a total of 18 cognitive tests scores: four tasks are in common with the cognitive tests in the Tracking cohort, and four tasks with multiple subtasks are added in the Comprehensive cohort. The four common cognitive tasks providing five test scores are: REYI measuring immediate memory recall; REYII measuring delayed memory recall; Animal Fluency (AF) measuring generative verbal fluency with two different scoring methods resulting in two scores, AF1 (strict scoring) and AF2 (lenient scoring); and Mental Alternation Test (MAT) measuring speeded alternation of ascending letters and numbers. The four additional tasks in the Comprehensive assessment, providing 13 additional scores, and five derived summary scores are: FAS measuring generative phonemic fluency for the letters F, A, and S (three scores summed to give a derived FAS total score); STP or the Stroop test scores for speeded naming of coloured dots, speeded reading of words, and speeded naming of text colour of incongruent colour words (three scores); two prospective memory tasks, a time-based prospective memory task (three scores combined into a derived TMT total score) and event-based prospective memory task (three scores combined into a derived PMT total score), and total prospective memory score; and the choice reaction time (CRT). The CRT task is not normed due to problems during baseline data collection with unstandardized administration procedures (i.e., placement of hand for timed trials to touch the screen was not standardized). The total prospective memory score was not normed because these two tasks measure different constructs. Stroop summary performance score is the Stroop interference ratio which is derived from the time to complete the incongruent colour-word naming task and the time to complete the dot task (2 versions, as described below).

For each of the eight cognitive scores – REYI, REYII, AFT (two versions), MAT, total FAS, STP interference (2 versions) – three normed scores are created that adjust for age, sex and education level, each having a different purpose and interpretation. The PMT_Event and TMT_Time summary scores are not normed because they are extremely skewed. Composite scores for the constructs of memory, executive functioning, and overall cognition are created from the key six normed scores. Lastly, cognitive impairment indicator variables are created for all individual test scores, including PMT and TMT scores, adjusted for age, sex and education

level, and overall cognitive impairment indicator variables based on a battery of tests are provided.

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.

A. SUMMARY OF DERIVED VARIABLES:

There are four general categories, with a total of 42 derived variables. See the Guide below in this section for when to use which derived variable(s).

1. Summary Scores for Cognitive tests in the Comprehensive assessment - 5 variables

- i. Stroop Interference Ratio
 - o Ratio score based on all available scores (STP_INTFR_RATIO_COM)
 - o A flag for extreme score, defined as a score > 3rd quartile + 3.0 × Inter-quartile range (STP_INTFR_RATIO_EXFLAG_COM)

- ii. FAS Total Score (FAS_TOTAL_SCORE_COM)
- iii. Prospective Memory tasks
 - o Event task (PMT_EVENT_SCORE_COM)
 - o Time task (TMT_TIME_SCORE_COM)

2. Normed Variables - 21 variables in total

For each of the seven test scores (REYI, REYII, AF1, AF2, MAT, FAS_TOTAL, and STP_INTFR_RATIO), three normed variables are provided:

- i. a Z-score (M = 0, SD = 1.0) (..._NORMED_ZSCORE_COM)
- ii. a scaled score (M = 10, SD = 3) (..._NORMED_SM10SD3_COM)
- iii. a normed score on the original test scale (M = weighted test score mean, SD = weighted test score SD) (..._NORMED_ORIGSCALE_COM)

For all normed scores, except the STP interference ratio on the original test scale, higher scores indicate better performance.

For the PMT and TMT, normed scores are not provided due to the ceiling effect on this task.

3. Composite Score Variables - 5 variables in total

- i. Memory latent construct score (scaled to M = 100, SD = 15) named COG_CONSTR_MEM_COM. This variable is the same for both the 4-test and 6-test batteries, since it consists only of the REY I and REY II.
- ii. Executive Function latent construct score (scaled to M = 100, SD = 15) named COG_CONSTR_EF2_COM and COG_CONSTR_EF4_COM
- iii. Overall Cognition latent construct scores (scaled to M = 100, SD = 15) named COG_CONSTR_OVERALLCOG4_COM and COG_CONSTR_OVERALLCOG6_COM

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

4. Cognitive Impairment Indicator (Binary) Variables - 11 variables in total

- i. Cognitive Impairment Indicator variables, one for each cognitive test score (REY I, REY II, AF2, MAT, STP_RATIO, FAS_TOTAL, PMT_EVENT, and TMT_TIME) (..._IMP_COM). Only AF2 impairment is computed because this scoring is closest to the version of AF used clinically.
- ii. Overall cognitive impairment variables, based on battery of tests consisting of:
 - o 4-test battery of tests in common with the Tracking assessment, named COG_OVERALL4_IMP_COM
 - o 6-test battery available in the Comprehensive assessment – 2 versions (because the percentages did not quite fall at the 5% cut-off point)
 - Impaired if participant falls in lowest 5.8% on the 6-test battery, named COG_OVERALL6_IMP_BELOW5PT8_COM
 - Severely impaired if participant falls in lowest 2% on the 6-test battery, named COG_OVERALL6_IMP_BELOW2_COM

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 <u>Normed and Standardized Variables</u>	<ul style="list-style-type: none"> normed Z Scores (..._NORMED_ZSCORE_COM), or normed Standard Scaled Scores (..._NORMED_SM10SD3_COM)
	...on cognitive constructs, use <u>Composite Variables</u> , for 6-test Comp battery	COG_CONSTR_MEM_COM, COG_CONSTR_EF4_COM, and/or COG_CONSTR_OVERALLCOG6_COM
	...on cognitive impairment on individual tests, use <u>Cognitive Impairment Indicator (Binary) Variables</u>	..._IMP_COM
	...on overall cognitive impairment on the 6-test battery of neuropsychological tests, use <u>Cognitive Impairment Indicator (Binary) Variable</u>	COG_OVERALL_IMP6_BELOW5PT8_COM for a stricter impairment criterion (participant falls in the lowest 5.8% of participants); or COG_OVERALL_IMP6_BELOW2_COM for a more lenient impairment criterion (participant falls in the lowest 2.0% of participants)
To incorporate the updated sampling weights into the normed scores...	...on individual tests, use the <u>Normed Variables on the Original Scale</u>	..._NORMED_ORIGSCALE_COM
To describe latent constructs of overall cognition or memory and executive functioning on 6-test COMP battery...	...use <u>Composite Variables</u> for 6-test battery	COG_CONSTR_MEM_COM, COG_CONSTR_EF4_TESTS_COM, and/or COG_CONSTR_OVERALLCOG6_COM
To assess impairment versus no impairment...	...on individual cognitive test, use <u>Cognitive Impairment Indicator (Binary) Variables</u>	..._IMP_COM
	...on 6-test battery, use the <u>Overall Cognitive Impairment Indicator (Binary) Variable</u>	COG_OVERALL_IMP6_BELOW5PT8_COM for a stricter impairment criterion (participant falls in the lowest 5.8% of participants); or COG_OVERALL_IMP6_BELOW2_COM for a more lenient impairment criterion (participant falls in the lowest 2.0% of participants)

Goal	Use Variable Class	Use Derived Variable(s)
To collapse or compare cognition measures across Tracking and Comprehensive cohorts (4 tests: REY I, REY II, AF2, and MAT)...	...on individual tests, use <u>Normed and Standardized Variables</u>	normed Z Scores (..._NORMED_ZSCORE_COM), or normed Standard Scaled Scores (..._NORMED_SM10SD3_COM)
	...individual tests on original scale and incorporating sampling weights	..._NORMED_ORIGSCALE_COM
	...on cognitive constructs, use <u>Composite Variables</u> for 4-test battery	COG_CONSTR_MEM_COM, COG_CONSTR_EF2_COM, and/or COG_CONSTR_OVERALLCOG4_COM
	...on <u>Cognitive Impairment Indicator (Binary) Variable</u> for 4-test battery	COG_OVERALL_IMP4_COM

B. DERIVED SUMMARY PERFORMANCE VARIABLES FOR STROOP, FAS AND PROSPECTIVE MEMORY TASKS

1. Stroop Interference Ratio Score

Derived Variable Name: STP_INTFR_RATIO_COM

Description: This variable is the Stroop interference ratio: the time it took the participant to complete the colour Stroop task divided by the time it took to complete the dot task. All available scores are included. Note that higher scores indicate greater interference and thus poorer performance.

Based on: STP_COLTIME_SS_COM, STP_DOTTIME_SS_COM

Derived Variable Specifications:

Value	Condition(s)	Description
STP_COLTIME_SS_COM / STP_DOTTIME_SS_COM	IF STP_COLTIME_SS_COM > 0 and IF STP_DOTTIME_SS_COM > 0	All scores are > 0. Scores > 1.0 indicate Stroop interference
(blank for missing)		Score is missing

2. Stroop Flag for Extreme Score

Derived Variable Name: STP_INTFR_RATIO_EXFLAG_COM

Description: This binary variable flags cases with a Stroop interference ratio greater than the upper extreme score limit (aka upper outer fence in a box plot), defined as $Q3 + 3.0 * \text{Interquartile range (IQR)}$. Cut-off scores for the extreme score limits are language dependent and are based on Stroop ratio distributions of the neuro-healthy CLSA norming English and French subsamples. Higher scores indicate greater interference and thus poorer performance.

Based on: STP_STARTLANG_COM, STP_INTFR_RATIO_COM

Derived Variable Specifications:

Value	Condition(s)	Description
0	IF STP_STARTLANG_COM = 'en' and STP_INTFR_RATIO_COM ≤ 4.4571; or IF STP_STARTLANG_COM = 'fr' and STP_INTFR_RATIO_COM ≤ 4.8006	For English- or French-speaking participants whose STP_RATIO_1 is within the respective defined calculated extreme score limit
1	IF STP_STARTLANG_COM = 'en' and STP_INTFR_RATIO_COM > 4.4571; or IF STP_STARTLANG_COM = 'fr' and STP_INTFR_RATIO_COM > 4.8006	For English- or French-speaking participants whose STP_RATIO_1 is larger than the extreme score limit
-77771	If missing STP_INTFR_RATIO_COM or missing STP_STARTLANG_COM	Cannot be determined due to missing data

3. FAS Summary Score

Derived Variable Name: FAS_TOTAL SCORE_COM

Description: This variable is the total score on the FAS task. It is a simple sum of the participant's score on the F, A, and S tasks.

Based on: FAS_F_SCORE_COM, FAS_A_SCORE_COM, FAS_S_SCORE_COM

Derived Variable Specifications:

Value	Condition(s)	Description
FAS_F_SCORE_COM + FAS_A_SCORE_COM + FAS_S_SCORE_COM	IF none of the three scores are missing	Total score on the FAS task
(blank for missing)		Score is missing

4. Prospective Memory - Event Task score

Derived Variable Name: PMT_EVENT_SCORE_COM

Description: This variable summarizes the participant's performance on the prospective memory event task.

Based on: PMT_ITP_COM, PMT_ACR_COM, PMT_REM_COM

Derived Variable Specifications:

Value	Condition(s)	Description
PMT_ITP_COM + PMT_ACR_COM + PMT_REM_COM	IF none of the three scores are missing	Possible scores are whole numbers from 0 to 9 (perfect score)
(blank for missing)		Score is missing

5. Prospective Memory - Time Task Score

Derived Variable Name: TMT_TIME_SCORE_COM

Description: This variable summarizes the participant's performance on the prospective memory time task.

Based on: TMT_ITPEXACT_COM, TMT_ACC_COM, TMT_RMD_COM

Derived Variable Specifications:

Value	Condition(s)	Description
TMT_ITPEXACT_COM + TMT_ACC_COM + TMT_RMD_COM	None of the three scores are missing	Possible scores are whole numbers from 0 to 9 (perfect score)
(blank for missing)		Score is missing

C. NORMED STANDARDIZED Z SCORES

1. REY I Z Score

Derived Variable Name: COG_REYI_NORMED_ZSCORE_COM

Description: This variable is the participant's REY I score, normed for the participant's 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 (M) = 0 and standard deviation (SD) = 1.0.

Based on: COG_REYI_STARTLANG_COM, COG_REYI_LANGUAGE_COM, COG_REYI_SCORE_COM, SEX_ASK_COM, ED_UDR04_COM, AGE_NMBR_COM

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_COM 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
REYI_LANG = 1	COG_REYI_STARTLANG_COM = 'en' and COG_REYI_LANGUAGE_COM = 'en'	REY I language of administration is English
REYI_LANG = 2	COG_REYI_STARTLANG_COM = 'fr' and COG_REYI_LANGUAGE_COM = 'fr'	REY I language of administration is French
REYI_LANG = blank for missing	Neither of the two conditions above are met	REY I language is missing or inconsistent
COG_REYI_PRED_COM = CONSTANT + COEFF * AGE_NMBR_COM,	REYI_LANG = (1, 2) and SEX_ASK_COM = ('M', 'F') and ED_UDR4_COM = (1, 2, 3, 4)	Regression-based predicted REY I score for English/French

Value	Condition(s)	Description
where CONSTANT and COEFF are estimates from linear regression models obtained from the neuro-healthy norming subsample in each condition		men/women with one of 4 levels of education and AGE_NMBR_COM years old

Derived Variable Specifications:

Value	Condition(s)	Description
(COG_REYI_PRED_COM – COG_REYI_SCORE_COM) / SD_RESID, where SD_RESID is the standard deviation of the residual (predicted – observed) scores of the participants in the particular English/French men/women with one of 4 levels of education group (obtained from the neuro-healthy norming sub sample)	REYI_LANG = (1, 2) and SEX_ASK_COM = ('M', 'F') and ED_UDR4_COM = (1, 2, 3, 4)	Age, sex and education-normed z-score on the REY I for English-/French-speaking participants
(blank for missing)		Score is missing

2. REY II Z Score

Derived Variable Name: COG_REYII_NORMED_ZSCORE_COM

Description: This variable is the participant’s REY II score, normed for the participant’s 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 (M) = 0 and standard deviation (SD) = 1.0.

Based on: COG_REYII_STARTLANG_COM, COG_REYII_LANGUAGE_COM, COG_REYII_SCORE_COM, SEX_ASK_COM, ED_UDR04_COM, AGE_NMBR_COM

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_COM 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_COM = 'en' and COG_REYII_LANGUAGE_COM = 'en'	REY II language of administration is English

Value	Condition(s)	Description
REYII_LANG = 2	COG_REYII_STARTLANG_COM = 'fr' and COG_REYII_LANGUAGE_COM = 'fr'	REY II language of administration is French
REYII_LANG = blank for missing	Neither of the two conditions above are met	REY II language is missing or inconsistent
COG_REYII_PRED_COM = CONSTANT + COEFF * AGE_NMBR_COM, where CONSTANT and COEFF are estimates from linear regression models obtained from the neuro-healthy norming sample stratified by sex and education level	REYII_LANG = (1, 2) and SEX_ASK_COM = ('M', 'F') and ED_UDR4_COM = (1, 2, 3, 4)	Regression-based predicted REY II score for English/French men/women with one of 4 levels of education and AGE_NMBR_COM years old

Derived Variable Specifications:

Value	Condition(s)	Description
(COG_REYII_PRED_COM – COG_REYII_SCORE_COM) / SD_RESID, where SD_RESID is the standard deviation of the residual (predicted – observed) scores of the participants in the particular English/French men/women with one of 4 levels of education group (obtained from the neuro-healthy norming sample)	REYII_LANG = (1, 2) and SEX_ASK_COM = ('M', 'F') and ED_UDR4_COM = (1, 2, 3, 4)	Age, sex and education-normed z-score on the REY II for English-/French-speaking participants
(blank for missing)		Score is missing

3. Animal Fluency-strict (AF1) Z Score

Derived Variable Name: COG_AF1_NORMED_ZSCORE_COM

Description: This variable is the participant's score, normed for the participant's 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 (M) = 0 and standard deviation (SD) = 1.0.

Based on: COG_AFT_STARTLANG_COM, COG_AFT_LANGUAGE_COM, COG_AFT_SCORE_1_COM, SEX_ASK_COM, ED_UDR04_COM, AGE_NMBR_COM

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_COM 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_COM = 'en' and COG_AFT_LANGUAGE_COM = 'en'	AFT language of administration is English
AFT_LANG = 2	COG_AFT_STARTLANG_COM = 'fr' and COG_AFT_LANGUAGE_COM = 'fr'	AFT language of administration is French
AFT_LANG = blank for missing	Neither of the two conditions above are met	AFT language is missing or inconsistent
COG_AF1_PRED_COM = CONSTANT + COEFF * AGE_NMBR_COM, where CONSTANT and COEFF are estimates from linear regression models obtained from the neuro-healthy norming sample stratified by sex and education level	AFT_LANG = (1, 2) and SEX_ASK_COM = ('M', 'F') and ED_UDR4_COM = (1, 2, 3, 4)	Regression-based predicted AF1 score for English/French men/women with one of 4 levels of education and AGE_NMBR_COM years old

Derived Variable Specifications:

Value	Condition(s)	Description
(COG_AF1_PRED_COM – COG_AF1_SCORE_COM) / SD_RESID, where SD_RESID is the standard deviation of the residual (predicted – observed) scores of the participants in the particular English/French men/women with one of 4 levels of education group (obtained from the neuro-healthy norming sample)	AFT_LANG = (1, 2) and SEX_ASK_COM = ('M', 'F') and ED_UDR4_COM = (1, 2, 3, 4)	Age, sex and education-normed z score on the AF-strict (AF1) for English-/French-speaking participants
(blank for missing)		Score is missing

4. Animal Fluency-lenient (AF2) Z Score

Derived Variable Name: COG_AF2_NORMED_ZSCORE_COM

Description: This variable is the participant’s score, normed for the participant’s 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 (M) = 0 and standard deviation (SD) = 1.0.

Based on: COG_AFT_STARTLANG_COM, COG_AFT_LANGUAGE_COM, COG_AFT_SCORE_2_COM, SEX_ASK_COM, ED_UDR04_COM, AGE_NMBR_COM

Temporary Variables: Two temporary variables are created. A language variable AFT_LANG is created for coding English or French test administration. The variable COG_AF2_PRED_COM 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_COM = ‘en’ and COG_AFT_LANGUAGE_COM = ‘en’	AFT language of administration is English
AFT_LANG = 2	COG_AFT_STARTLANG_COM = ‘fr’ and COG_AFT_LANGUAGE_COM = ‘fr’	AFT language of administration is French
AFT_LANG = blank for missing	Neither of the two conditions above are met	AFT language is missing or inconsistent
COG_AF2_PRED_COM = CONSTANT + COEFF * AGE_NMBR_COM, where CONSTANT and COEFF are estimates from linear regression models obtained from the neuro-healthy norming sample stratified by sex and education level	AFT_LANG = (1, 2) and SEX_ASK_COM = (‘M’, ‘F’) and ED_UDR4_COM = (1, 2, 3, 4)	Regression-based predicted AF2 score for English/French men/women with one of 4 levels of education and AGE_NMBR_COM years old

Derived Variable Specifications:

Value	Condition(s)	Description
$(\text{COG_AF2_PRED_COM} - \text{COG_AF2_SCORE_COM}) / \text{SD_RESID}$, where SD_RESID is the standard deviation of the residual (predicted – observed) scores of the participants in the particular English/French men/women with one of 4 levels of education group (obtained from the neuro-healthy norming sample)	AFT_LANG = (1, 2) and SEX_ASK_COM = (‘M’, ‘F’) and ED_UDR4_COM = (1, 2, 3, 4)	Age, sex and education-normed z score on the AF-lenient (AF2) for English-/French-speaking participants
(blank for missing)		Score is missing

5. Mental Alteration Test (MAT) Z Score

Derived Variable Name: COG_MAT_NORMED_ZSCORE_COM

Description: This variable is the participant’s score, normed for the participant’s 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 (M) = 0 and standard deviation (SD) = 1.0.

Based on: COG_MAT_STARTLANG_COM, COG_MAT_LANGUAGE_COM, COG_MAT_SCORE_COM, SEX_ASK_COM, ED_UDR04_COM, AGE_NMBR_COM

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_COM 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_COM = ‘en’ and COG_MAT_LANGUAGE_COM = ‘en’	MAT language of administration is English
MAT_LANG = 2	COG_MAT_STARTLANG_COM = ‘fr’ and COG_MAT_LANGUAGE_COM = ‘fr’	MAT language of administration is French
MAT_LANG = blank for missing	Neither of the two conditions above are met	MAT language is missing or inconsistent
COG_MAT_PRED_COM = CONSTANT + COEFF * AGE_NMBR_COM, where CONSTANT and COEFF are estimates from linear regression models obtained from the neuro- healthy norming sample stratified by sex and education level	MAT_LANG = (1, 2) and SEX_ASK_COM = (‘M’, ‘F’) and ED_UDR4_COM = (1, 2, 3, 4)	Regression-based predicted score for English/French men/women with one of 4 levels of education and AGE_NMBR_COM years old

Derived Variable Specifications:

Value	Condition(s)	Description
$(\text{COG_MAT_PRED_COM} - \text{COG_MAT_SCORE_COM}) / \text{SD_RESID}$, where SD_RESID is the standard deviation of the residual (predicted – observed) scores of the participants in the particular English/French men/women with one of 4 levels of education group (obtained from the neuro-healthy norming sample)	MAT_LANG = (1, 2) and SEX_ASK_COM = ('M', 'F') and ED_UDR4_COM = (1, 2, 3, 4)	Age, sex and education-normed z score on the MAT for English-/French-speaking participants
(blank for missing)		Score is missing

6. Stroop Interference Ratio Z Score

Derived Variable Name: STP_RATIO_NORMED_ZSCORE_COM

Description: This variable is the participant’s score, normed for the participant’s 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 (M) = 0 and standard deviation (SD) = 1.0. The sign of the normed score is reversed so that higher scores indicate better performance.

Based on: STP_STARTLANG_COM, STP_INTFR_RATIO_COM, SEX_ASK_COM, ED_UDR04_COM, AGE_NMBR_COM

Temporary Variable: One temporary variable is created. The variable STP_RATIO_PRED_COM is the participant’s predicted test score based on her/his language of administration, age, sex and education level. This variable is not included in the CLSA dataset.

Value	Condition(s)	Description
$\text{STP_RATIO_PRED_COM} = \text{CONSTANT} + \text{COEFF} * \text{AGE_NMBR_COM}$, where CONSTANT and COEFF are estimates from linear regression models obtained from the neuro-healthy norming sample stratified by sex and education level	STP_STARTLANG_COM = ('en', 'fr') and SEX_ASK_COM = ('M', 'F') and ED_UDR4_COM = (1, 2, 3, 4)	Regression-based predicted score for English/French men/women with one of 4 levels of education and AGE_NMBR_COM years old

Derived Variable Specifications:

Value	Condition(s)	Description	Notes
- (STP_RATIO_PRED_COM – STP_INTFR_RATIO_COM) / SD_RESID, where SD_RESID is the standard deviation of the residual (predicted – observed) scores of the participants in each condition obtained from the norming subsample	STP_STARTLANG_COM = ('en', 'fr') and SEX_ASK_COM = ('M', 'F') and ED_UDR4_COM = (1, 2, 3, 4)	Age, sex and education-normed z score on the STP for English-/French-speaking participants	Note that the sign has been reversed so that higher scores indicate better performance
(blank for missing)		Score is missing	

7. FAS Total Z Score

Derived Variable Name: FAS_NORMED_ZSCORE_COM

Description: This variable is the participant’s score, normed for the participant’s 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 (M) = 0 and standard deviation (SD) = 1.0.

Based on: FAS_STARTLANG_COM, FAS_F_LANG_COM, FAS_A_LANG_COM, FAS_S_LANG_COM, FAS_TOTAL_SCORE_COM, SEX_ASK_COM, ED_UDR04_COM, AGE_NMBR_COM

Temporary Variable: Two temporary variables are created. A language variable FAS_ALL_LANG is created for coding English or French test administration. The variable FAS_TOTAL_PRED_COM 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
FAS_ALL_LANG = 1	FAS_STARTLANG_COM = 'en' and FAS_F_LANG_COM = 'en' and FAS_A_LANG_COM = 'en' and FAS_S_LANG_COM = 'en'	The participant did all parts of the FAS task in English
FAS_ALL_LANG = 2	FAS_STARTLANG_COM = 'fr' and FAS_F_LANG_COM = 'fr' and FAS_A_LANG_COM = 'fr' and FAS_S_LANG_COM = 'fr'	The participant did all parts of the FAS task in French
FAS_ALL_LANG = blank for missing	Neither of the two conditions above are met	FAS language is missing or inconsistent
FAS_TOTAL_PRED_COM = CONSTANT + COEFF * AGE_NMBR_COM,	FAS_ALL_LANG = (1, 2) and SEX_ASK_COM = ('M', 'F') and ED_UDR4_COM = (1, 2, 3, 4)	Regression-based predicted score for English/French men/women with one of 4 levels of education

Value	Condition(s)	Description
where CONSTANT and COEFF are estimates from linear regression models obtained from the neuro-healthy norming subsample stratified by sex and education level		and AGE_NMBR_COM years old

Derived Variable Specifications:

Value	Condition(s)	Description
$(FAS_TOTAL_PRED_COM - FAS_TOTAL_SCORE_COM) / SD_RESID$, where SD_RESID is the standard deviation of the residual (predicted – observed) scores of the participants in each condition obtained from the norming subsample	FAS_ALL_LANG = (1, 2) and SEX_ASK_COM = ('M', 'F') and ED_UDR4_COM = (1, 2, 3, 4)	Age, sex and education-normed z score on the FAS for English-/French-speaking participants
(blank for missing)		Score is missing

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

1. REY I Scaled Score

Derived Variable Name: COG_REYI_NORMED_SM10SD3_COM

Description: This variable is the participant's REY I 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 are on a scale with mean (M) = 10 and standard deviation (SD) = 3.0. Negative scaled scores are replaced with 0.01.

Based on: COG_REYI_NORMED_ZSCORE_COM

Derived Variable Specifications:

Value	Condition(s)	Description
$(COG_REYI_NORMED_ZSCORE_COM * 3) + 10$	Not missing COG_REYI_NORMED_ZSCORE_COM	Age, sex and education normed score on the REY I, re-scaled to a scale with a M = 10 and SD = 3
(blank for missing)		Score is missing

2. REY II Scaled Score

Derived Variable Name: COG_REYII_NORMED_SM10SD3_COM

Description: This variable is the participant's REY II 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 are on a scale with mean (M) = 10 and standard deviation (SD) = 3.0. Negative scaled scores are replaced with 0.01.

Based on: COG_REYII_NORMED_ZSCORE_COM

Derived Variable Specifications:

Value	Condition(s)	Description
(COG_REYII_NORMED_ZSCORE_COM *3) + 10	Not missing COG_REYII_NORMED_ZSCORE_COM	Age, sex and education normed score on the REY II, 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_COM

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 are on a scale with mean (M) = 10 and standard deviation (SD) = 3.0. Negative scaled scores are replaced with 0.01.

Based on: COG_AF1_NORMED_ZSCORE_COM

Derived Variable Specifications:

Value	Condition(s)	Description
(COG_AF1_NORMED_ZSCORE_COM *3) + 10	Not missing COG_AF1_NORMED_ZSCORE_COM	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_COM

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 are on a scale with mean (M) = 10 and standard deviation (SD) = 3.0. Negative scaled scores are replaced with 0.01.

Based on: COG_AF2_NORMED_ZSCORE_COM

Derived Variable Specifications:

Value	Condition(s)	Description
$(\text{COG_AF2_NORMED_ZSCORE_COM} * 3) + 10$	Not missing COG_AF2_ NORMED_ZSCORE_COM	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_COM

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 are on a scale with mean (M) = 10 and standard deviation (SD) = 3.0. Negative scaled scores are replaced with 0.01.

Based on: COG_MAT_NORMED_ZSCORE_COM

Derived Variable Specifications:

Value	Condition(s)	Description
$(\text{COG_MAT_NORMED_ZSCORE_COM} * 3) + 10$	Not missing COG_MAT_NORMED_ ZSCORE_COM	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

6. Stroop Interference Ratio Scaled Score

Derived Variable Name: STP_RATIO_NORMED_SM10SD3_COM

Description: This variable is the participant's Stroop interference ratio 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 are on a scale with mean (M) = 10 and standard deviation (SD) = 3.0. As with the original scale, higher scores indicate worse performance. Negative scaled scores are replaced with 0.01.

Based on: STP_RATIO_NORMED_ZSCORE_COM

Derived Variable Specifications:

Value	Condition(s)	Description
$(\text{STP_RATIO_NORMED_ZSCORE_COM} * 3) + 10$	Not missing STP_RATIO_NORMED_ ZSCORE_COM	Age, sex and education normed score on the STP task, re-scaled to a scale with a M = 10 and SD = 3
(blank for missing)		Score is missing

7. FAS Total Scaled Score

Derived Variable Name: FAS_TOTAL_NORMED_SM10SD3_COM

Description: This variable is the participant's FAS total 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 a scale with mean (M) = 10 and standard deviation (SD) = 3.0. Negative scaled scores are replaced with 0.01.

Based on: FAS_TOTAL_NORMED_ZSCORE_COM

Derived Variable Specifications:

Value	Condition(s)	Description
$(FAS_TOTAL_NORMED_ZSCORE_COM * 3) + 10$	Not missing FAS_TOTAL_NORMED_ZSCORE_COM	Age, sex and education normed score on the STP task, re-scaled to a scale with a M = 10 and SD = 3
(blank for missing)		Score is missing

E. NORMED SCORES ON THE ORIGINAL TEST SCALE

1. REY I Normed Original Score

Derived Variable Name: COG_REYI_NORMED_ORIGSCALE_COM

Description: This variable is the participant's REY I 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 REY I scores (ranging from 0 to 15), rescaled using the weighted means and standard deviations (using CLSA_COM inflation weights v1.2) of the neuro-healthy English/French CLSA norming subsamples.

Based on: REYI_LANG, COG_REYI_NORMED_ZSCORE_COM

Derived Variable Specifications:

Value	Condition(s)	Description
$(COG_REYI_NORMED_ZSCORE_COM * WTD_SD) + WTD_MEAN,$ Where WTD_SD is the weighted standard deviation (English = 1.870; French = 1.816) and WTD_MEAN is the weighted mean (English = 6.017; French = 5.554) of REY I scores of the neuro-healthy CLSA norming subsample	IF REYI_LANG = (1, 2) And not missing COG_REYI_NORMED_ZSCORE_COM	Normed score on the original REYI scale adjusted for sampling weights
(blank for missing)		Score is missing

2. REY II Normed Original Score

Derived Variable Name: COG_REYII_NORMED_ORIGSCALE_COM

Description: This variable is the participant’s REY II 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 REY II scores (ranging from 0 to 15), rescaled using the weighted means and standard deviations (using CLSA_COM inflation weights v1.2) of the neuro-healthy English/French CLSA norming subsamples.

Based on: REYII_LANG, COG_REYII_NORMED_ZSCORE_COM

Derived Variable Specifications:

Value	Condition(s)	Description
$(\text{COG_REYII_NORMED_ZSCORE_COM} * \text{WTD_SD}) + \text{WTD_MEAN}$, where WTD_SD is the weighted standard deviation (English = 2.177; French = 2.014) and WTD_MEAN is the weighted mean (English = 4.225; French = 4.011) of REY II scores of the neuro-healthy CLSA norming subsample	IF REYII_LANG = (1, 2) and not missing COG_REYII_NORMED_ZSCORE_COM	Normed score on the original REYII scale adjusted for sampling weights
(blank for missing)		Score is missing

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

Derived Variable Name: COG_AF1_NORMED_ORIGSCALE_COM

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_COM inflation weights v1.2) of the neuro-healthy English/French CLSA norming subsamples.

Based on: AFT_LANG, COG_AF1_NORMED_ZSCORE_COM

Derived Variable Specifications:

Value	Condition(s)	Description
$(\text{COG_AF1_NORMED_ZSCORE_COM} * \text{WTD_SD}) + \text{WTD_MEAN}$, where WTD_SD is the weighted standard deviation (English = 5.756; French = 5.315) and WTD_MEAN is the weighted mean (English = 20.146; French = 18.346) of AF1 scores of the neuro-healthy CLSA norming subsample	IF AFT_LANG = (1, 2) and not missing COG_AF1_NORMED_ZSCORE_COM	Normed score on the original AF1 scale adjusted for sampling weights
(blank for missing)		Score is missing

4. Animal Fluency-Ienient (AF2) Normed Original Score

Derived Variable Name: COG_AF2_NORMED_ORIGSCALE_COM

Description: This variable is the participant's Animal Fluency-Ienient (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_COM inflation weights v1.2) of the neuro-healthy English/French CLSA norming subsamples.

Based on: AFT_LANG, COG_AF2_NORMED_ZSCORE_COM

Derived Variable Specifications:

Value	Condition(s)	Description
$(\text{COG_AF2_NORMED_ZSCORE_COM} * \text{WTD_SD}) + \text{WTD_MEAN}$, where WTD_SD is the weighted standard deviation (English = 6.528; French = 5.960) and WTD_MEAN is the weighted mean (English = 21.975; French = 19.763) of AF2 scores of the neuro-healthy CLSA norming subsample	IF AFT_LANG = (1, 2) and not missing COG_AF2_NORMED_ZSCORE_COM	Normed score on the original AF2 scale adjusted for sampling weights
(blank for missing)		Score is missing

5. MAT Normed Original Score

Derived Variable Name: COG_MAT_NORMED_ORIGSCALE_COM

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_COM inflation weights v1.2) of the neuro-healthy English/French CLSA norming subsamples.

Based on: MAT_LANG, COG_MAT_NORMED_ZSCORE_COM

Derived Variable Specifications:

Value	Condition(s)	Description
$(\text{COG_MAT_NORMED_ZSCORE_COM} * \text{WTD_SD}) + \text{WTD_MEAN}$, where WTD_SD is the weighted standard deviation (English = 7.875; French = 7.979) and WTD_MEAN is the weighted mean (English = 27.385; French = 26.710) of MAT scores of the neuro-healthy CLSA norming subsample	IF MAT_LANG = (1, 2) and not missing COG_MAT_NORMED_ZSCORE_COM	Normed score on the original MAT scale adjusted for sampling weights
(blank for missing)		Score is missing

6. Stroop Interference Ratio Normed Original Score

Derived Variable Name: STP_RATIO_NORMED_ORIGSCALE_COM

Description: This variable is the participant's STP interference ratio 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 STP ratio scores, rescaled using the weighted means and standard deviations (using CLSA_COM inflation weights v1.2) of the neuro-healthy English/French CLSA norming subsamples. As with the original un-normed scores, higher scores indicate worse performance.

Based on: STP_STARTLANG_COM, STP_RATIO_NORMED_ZSCORE_COM

Derived Variable Specifications:

Value	Condition(s)	Description
- (STP_RATIO_NORMED_ZSCORE_COM * WTD_SD) + WTD_MEAN, where WTD_SD is the weighted standard deviation (English = 0.690; French = 0.984) and WTD_MEAN is the weighted mean (English = 2.096; French = 2.196) of STP ratio scores of the neuro-healthy CLSA norming subsample	IF STP_STARTLANG_COM = 'en', 'fr') and not missing STP_RATIO_NORMED_ZSCORE_COM	Normed score on the original STP Interference Ratio scale adjusted for sampling weights and based on all STP_RATIO scores
(blank for missing)		Score is missing

7. FAS Total Normed Original Score

Derived Variable Name: FAS_TOTAL_NORMED_ORIGSCALE_COM

Description: This variable is the participant's FAS 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 FAS scores, rescaled using the weighted means and standard deviations (using CLSA_COM inflation weights v1.2) of the neuro-healthy English/French CLSA norming subsamples.

Based on: FAS_ALL_LANG, FAS_TOTAL_NORMED_ZSCORE_COM

Derived Variable Specifications:

Value	Condition(s)	Description
$(FAS_TOTAL_NORMED_ZSCORE_COM * WTD_SD) + WTD_MEAN,$ where WTD_SD is the weighted standard deviation (English = 12.629; French = 11.646) and WTD_MEAN is the weighted mean (English = 39.899; French = 35.056) of FAS total scores of the neuro-healthy CLSA norming subsample	IF FAS_ALL_LANG = (1, 2) and not missing FAS_TOTAL_NORMED_ZSCORE_COM	Normed score on the original FAS_TOTAL scale adjusted for sampling weights
(blank for missing)		Score is missing

F. COMPOSITE VARIABLES

1. Memory Latent Construct Variable

Derived Variable Name: COG_CONSTR_MEM_COM

Description: A latent construct index variable (M = 100, SD = 15) providing a combined memory score for the neuropsychological test battery. It is the same for both 4-test battery in common with the Tracking assessment cohort and the 6-test comprehensive battery. It is language invariant. It can only be computed if both REY I and REY II scores are not missing.

Based on: COG_REYI_NORMED_SM10SD3_COM, COG_REYII_NORMED_SM10SD3_COM

Derived Variable Specifications:

Value	Condition(s)	Description
$((COG_REYI_NORMED_SM10SD3_COM + COG_REYII_NORMED_SM10SD3_COM - 20.026) / 5.413) * 15 + 100$	If not missing COG_REYI_NORMED_SM10SD3_COM and not missing COG_REYII_NORMED_SM10SD3_COM	Score on the memory construct, scaled to M = 100, SD = 15
(blank for missing)		Score is missing

2. Executive Functioning Latent Construct Variable for 4-COG-test battery

Derived Variable Name: COG_CONSTR_EF2_COM

Description: A latent construct index variable (M = 100, SD = 15) providing a combined executive functioning score for the 4-cognitive test battery consisting of cognitive tests in common with the Tracking assessment cohort. It is language invariant.

Based on: COG_AF2_NORMED_SM10SD3_COM, COG_MAT_NORMED_SM10SD3_COM

Derived Variable Specifications:

Value	Condition(s)	Description
$((\text{COG_AF2_NORMED_SM10SD3_COM} + \text{COG_MAT_NORMED_SM10SD3_COM} - 20.013) / 4.857) * 15 + 100$	COG_AF2_NORMED_SM10SD3_COM = Not missing and COG_MAT_NORMED_SM10SD3_COM = Not missing	Score on the executive functioning construct, scaled to M = 100, SD = 15
(blank for missing)		Score is missing

3. Executive Functioning Latent Construct Variable for 6-COG test battery

Derived Variable Name: COG_CONSTR_EF4_COM

Description: A latent construct index variable (M = 100, SD = 15) providing a combined executive functioning score for the 6-cognitive test battery in the Comprehensive assessment. It is language invariant.

Based on: COG_AF2_NORMED_SM10SD3_COM, COG_MAT_NORMED_SM10SD3_COM, STP_RATIO_NORMED_SM10SD3_COM, FAS_TOTAL_NORMED_SM10SD3_COM

Derived Variable Specifications:

Value	Condition(s)	Description
$((\text{COG_AF2_NORMED_SM10SD3_COM} + \text{COG_MAT_NORMED_SM10SD3_COM} + \text{STP_RATIO_NORMED_SM10SD3_COM} + \text{FAS_TOTAL_NORMED_SM10SD3_COM} - 40.095) / 7.533) * 15 + 100$	COG_AF2_NORMED_SM10SD3_COM = Not missing and COG_MAT_NORMED_SM10SD3_COM = Not missing and STP_RATIO_NORMED_SM10SD3_COM = Not missing and FAS_TOTAL_NORMED_SM10SD3_COM = Not missing	Score on the executive functioning construct, scaled to M = 100, SD = 15
(blank for missing)		Score is missing

4. Overall Cognition Latent Construct Variable for 4-COG test battery

Derived Variable Name: COG_CONSTR_OVERALLCOG4_COM

Description: A latent construct index variable (M = 100, SD = 15) providing an overall cognition score for the 4-cognitive test battery. It is language invariant.

Based on: COG_REYI_NORMED_SM10SD3_COM, COG_REYII_NORMED_SM10SD3_COM, COG_AF2_NORMED_SM10SD3_COM, COG_MAT_NORMED_SM10SD3_COM

Derived Variable Specifications:

Value	Condition(s)	Description
$((\text{COG_REYI_NORMED_SM10SD3_COM} + \text{COG_REYII_NORMED_SM10SD3_COM} + \text{COG_AF2_NORMED_SM10SD3_COM} + \text{COG_MAT_NORMED_SM10SD3_COM} - 40.039) / 8.290) * 15 + 100$	COG_REYI_NORMED_SM10SD3_COM = Not missing and COG_REYII_NORMED_SM10SD3_COM = Not missing and COG_AF2_NORMED_SM10SD3_COM = Not missing and COG_MAT_NORMED_SM10SD3_COM = Not missing	Score on the overall cognition function construct, scaled to M = 100, SD = 15
(blank for missing)		Score is missing

5. Overall Cognition Latent Construct Variable for 6-COG test battery

Derived Variable Name: COG_CONSTR_OVERALLCOG6_COM

Description: A latent construct index variable (M = 100, SD = 15) providing an overall cognition score for the 6-cognitive test battery. It is language invariant.

Based on: COG_REYI_NORMED_SM10SD3_COM, COG_REYII_NORMED_SM10SD3_COM, COG_AF2_NORMED_SM10SD3_COM, COG_MAT_NORMED_SM10SD3_COM, STP_RATIO_NORMED_SM10SD3_COM, FAS_TOTAL_NORMED_SM10SD3_COM

Derived Variable Specifications:

Value	Condition(s)	Description
$((\text{COG_REYI_NORMED_SM10SD3_COM} + \text{COG_REYII_NORMED_SM10SD3_COM} + \text{COG_AF2_NORMED_SM10SD3_COM} + \text{COG_MAT_NORMED_SM10SD3_COM} + \text{STP_RATIO_NORMED_SM10SD3_COM} + \text{FAS_TOTAL_NORMED_SM10SD3_COM} - 60.121) / 10.533) * 15 + 100$	COG_REYI_NORMED_SM10SD3_COM = Not missing and COG_REYII_NORMED_SM10SD3_COM = Not missing and COG_AF2_NORMED_SM10SD3_COM = Not missing and COG_MAT_NORMED_SM10SD3_COM = Not missing and STP_RATIO_NORMED_SM10SD3_COM = Not missing and FAS_TOTAL_NORMED_SM10SD3_COM = Not missing	Score on the overall cognition function construct for 6-test battery, scaled to M = 100, SD = 15
(blank for missing)		Score is missing

G. COGNITIVE IMPAIRMENT INDICATOR VARIABLES

1. REY I Cognitive Impairment Variable

Derived Variable Name: COG_REYI_IMP_COM

Description: A binary-valued variable that indicates whether the participant’s normed REY I score falls in the lowest 5% of the neuro-healthy CLSA norming subsample. The cut-off value for impairment is language dependent.

Based on: REYI_LANG, COG_REYI_NORMED_ZSCORE_COM

Derived Variable Specifications:

Value	Condition(s)	Description
0	(COG_REYI_NORMED_ZSCORE_COM ≥ -1.556 and REYI_LANG = 1) or (COG_REYI_NORMED_ZSCORE_COM ≥ -1.547 and REYI_LANG = 2)	Not impaired on REY I
1	(COG_REYI_NORMED_ZSCORE_COM < -1.556 and REYI_LANG = 1) or (COG_REYI_NORMED_ZSCORE_COM < -1.547 IF REYI_LANG = 2)	Impaired on REY I (in lowest 5% of healthy participants)
-77771	COG_REYI_NORMED_ZSCORE_COM = missing	Unable to determine due to missing REY I score

2. REY II Cognitive Impairment Variable

Derived Variable Name: COG_REYII_IMP_COM

Description: A binary-valued variable that indicates whether the participant’s normed REY II score falls in the lowest 5% of the neuro-healthy CLSA norming subsample. The cut-off value for impairment is language dependent.

Based on: REYII_LANG, COG_REYII_NORMED_ZSCORE_COM

Derived Variable Specifications:

Value	Condition(s)	Description
0	(COG_REYII_NORMED_ZSCORE_COM ≥ -1.650 and REYII_LANG = 1) or (COG_REYII_NORMED_ZSCORE_COM ≥ -1.563 and REYII_LANG = 2)	Not impaired on REY II
1	(COG_REYII_NORMED_ZSCORE_COM < -1.650 and REYII_LANG = 1) or (COG_REYII_NORMED_ZSCORE_COM < -1.563 and REYII_LANG = 2)	Impaired on REY II (in lowest 5% of healthy participants)
-77771	COG_REYII_NORMED_ZSCORE_COM = missing	Unable to determine due to missing REY II score

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

Derived Variable Name: COG_AF2_IMP_COM

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 subsample. The cut-off value for impairment is language dependent.

Based on: AFT_LANG, COG_AF2_NORMED_ZSCORE_COM

Derived Variable Specifications:

Value	Condition(s)	Description
0	(COG_AF2_NORMED_ZSCORE_COM \geq -1.568 and AFT_LANG = 1) or (COG_AF2_NORMED_ZSCORE_COM \geq -1.607 and AFT_LANG = 2)	Not impaired on AF2
1	(COG_AF2_NORMED_ZSCORE_COM $<$ -1.568 and AFT_LANG = 1) or (COG_AF2_NORMED_ZSCORE_COM $<$ -1.607 and AFT_LANG = 2)	Impaired on AF2 (in lowest 5% of healthy participants)
-77771	COG_AF2_NORMED_ZSCORE_COM = missing	Unable to determine due to missing AF2 score

4. Mental Alteration Test (MAT) Cognitive Impairment Variable

Derived Variable Name: COG_MAT_IMP_COM

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 subsample. The cut-off value for impairment is language dependent.

Based on: MAT_LANG, COG_MAT_NORMED_ZSCORE_COM

Derived Variable Specifications:

Value	Condition(s)	Description
0	(COG_MAT_NORMED_ZSCORE_COM \geq -1.630 and MAT_LANG = 1) or (COG_MAT_NORMED_ZSCORE_COM \geq -1.726 and MAT_LANG = 2)	Not impaired on MAT
1	(COG_MAT_NORMED_ZSCORE_COM $<$ -1.630 and MAT_LANG = 1) or (COG_MAT_NORMED_ZSCORE_COM $<$ -1.726 and MAT_LANG = 2)	Impaired on MAT (in lowest 5% of healthy participants)
-77771	COG_MAT_NORMED_ZSCORE_COM = missing	Unable to determine due to missing MAT score

5. Stroop Interference Ratio Cognitive Impairment Variable

Derived Variable Name: STP_RATIO_IMP_COM

Description: A binary-valued variable that indicates whether the participant's normed STP ratio score falls in the lowest 5% of the neuro-healthy CLSA norming subsample. The cut-off value for impairment is language dependent.

Based on: STP_STARTLANG_COM, STP_RATIO_NORMED_ZSCORE_COM

Derived Variable Specifications:

Value	Condition(s)	Description
0	(STP_RATIO_NORMED_ZSCORE_COM \geq -1.445 and STP_STARTLANG_COM = 'en') or (STP_RATIO_NORMED_ZSCORE_COM \geq -1.544 and STP_STARTLANG_COM = 'fr')	Not impaired on STP task
1	(STP_RATIO_NORMED_ZSCORE_COM $<$ -1.445 and STP_STARTLANG_COM = 'en') or (STP_RATIO_NORMED_ZSCORE_COM $<$ -1.544 and STP_STARTLANG_COM = 'fr')	Impaired on STP task (in lowest 5% of healthy participants)
-77771	STP_RATIO_NORMED_ZSCORE_COM = missing	Unable to determine due to missing STP ratio score

6. FAS Total Score Cognitive Impairment Variable

Derived Variable Name: FAS_TOTAL_IMP_COM

Description: A binary-valued variable that indicates whether the participant's normed FAS total score falls in the lowest 5% of the neuro-healthy CLSA norming subsample. The cut-off value for impairment is language dependent.

Based on: FAS_ALL_LANG, FAS_TOTAL_NORMED_ZSCORE_COM

Derived Variable Specifications:

Value	Condition(s)	Description
0	(FAS_TOTAL_NORMED_ZSCORE_COM \geq -1.568 and FAS_ALL_LANG = 1) or (FAS_TOTAL_NORMED_ZSCORE_COM \geq -1.584 and FAS_ALL_LANG = 2)	Not impaired on FAS
1	FAS_TOTAL_NORMED_ZSCORE_COM $<$ -1.568 and FAS_ALL_LANG = 1 or FAS_TOTAL_NORMED_ZSCORE_COM $<$ -1.584 and FAS_ALL_LANG = 2	Impaired on FAS (in lowest 5% of healthy participants)
-77771	FAS_TOTAL_NORMED_ZSCORE_COM = missing	Unable to determine due to missing or inconsistent FAS scores

7. Overall Cognitive Impairment on 4-Cognitive Test Battery

Derived Variable Name: COG_OVERALL4_IMP_COM

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 CLSA sample.

Based on: COG_REYI_IMP_COM, COG_REYII_IMP_COM, COG_AF2_IMP_COM, COG_MAT_IMP_COM

Temporary Variables: Two variables are created. One variable counts the number of missing cognitive test scores for the 4-test battery: COG_NB_MISSING_4TESTS_COM. The second variable counts the number of test scores in the impairment range: COG_NMBR_IMP_4TESTS_COM. These variables are not included in the CLSA dataset.

Value	Condition(s)	Description
COG_NB_MISSING_4TESTS_COM = count of missing test scores		Number of tests (REYI, REYII, AF2 and MAT) that have missing values; possible values are 0, 1, 2, 3 or 4
COG_NMBR_IMP_4TESTS_COM = COG_REYI_IMP_COM + COG_REYII_IMP_COM + COG_AF2_IMP_COM + COG_MAT_IMP_COM	IF COG_NB_MISSING_4TESTS_COM = 0	Number of cognitive test scores in impaired range; possible values are 0, 1, 2, 3 or 4

Derived Variable Specifications:

Value	Condition(s)	Description
0	COG_NMBR_IMP_4TESTS_COM ≤ 1	Not overall cognitively impaired
1	COG_NMBR_IMP_4TESTS_COM ≥ 2	Overall cognitive impairment is indicated
-77771	COG_NMBR_IMP_4TESTS_COM = missing	Unable to determine due to missing values

8. Overall Cognitive Impairment on 6-Cognitive Test Battery at 5.8%

Derived Variable Name: COG_OVERALL6_IMP_BELOW5PT8_COM

Description: A binary-valued variable that indicates whether the participant’s overall cognitive performance on the battery of six cognitive tests falls in the lowest 5.8% of the CLSA sample.

Based on: COG_REYI_IMP_COM, COG_REYII_IMP_COM, COG_AF2_IMP_COM, COG_MAT_IMP_COM, STP_RATIO_IMP_2_COM, FAS_TOTAL_IMP_COM

Temporary Variables: Two variables are created. One variable counts the number of missing cognitive test scores for the 6-test battery: COG_NB_MISSING_6TESTS_COM. The second variable counts the number of test scores in the impairment range: COG_NMBR_IMP_6TESTS_COM. These variables are not included in the CLSA dataset.

Value	Condition(s)	Description
COG_NB_MISSING_6TESTS_COM = count of missing test scores		Number of tests (REYI, REYII, AF2, MAT, STP, and FAS) that have missing values; possible values are 0, 1, 2, 3, 4, 5 or 6
COG_NMBR_IMP_6TESTS_COM = COG_REYI_IMP_COM + COG_REYII_IMP_COM + COG_AF2_IMP_COM + COG_MAT_IMP_COM + STP_RATIO_IMP_COM + FAS_TOTAL_IMP_COM	IF COG_NB_MISSING_6TESTS_COM = 0	Number of cognitive test scores in impaired range; possible values are 0, 1, 2, 3, 4, 5 or 6

Derived Variable Specifications:

Value	Condition(s)	Description
0	COG_NMBR_IMP_6TESTS_COM ≤ 1	Not overall cognitively impaired
1	COG_NMBR_IMP_6TESTS_COM ≥ 2	Overall cognitive impairment is indicated
-77771	COG_NMBR_IMP_6TESTS_COM = missing	Unable to determine due to missing values

9. Overall Cognitive Impairment on 6-Cognitive Test Battery at 2.0%

Derived Variable Name: COG_OVERALL6_IMP_BELOW2_COM

Description: A binary-valued variable that indicates whether the participant's overall cognitive performance on the battery of six cognitive tests falls in the lowest 2% of the CLSA sample.

Based on: COG_REYI_IMP_COM, COG_REYII_IMP_COM, COG_AF2_IMP_COM, COG_MAT_IMP_COM, STP_RATIO_IMP_COM, FAS_TOTAL_IMP_COM

Temporary Variables: Two variables are created. One variable counts the number of missing cognitive test scores for the 6-test battery: COG_NB_MISSING_6TESTS_COM. The second variable counts the number of test scores in the impairment range: COG_NMBR_IMP_6TESTS_COM. These variables are not included in the CLSA dataset.

Value	Condition(s)	Description
COG_NB_MISSING_6TESTS_COM = count of missing test scores		Number of tests (REYI, REYII, AF2, MAT, STP_2, and FAS) with missing values; possible values are 0, 1, 2, 3, 4, 5 or 6

Value	Condition(s)	Description
COG_NMBR_IMP_6TESTS_COM = COG_REYI_IMP_COM + COG_REYII_IMP_COM + COG_AF2_IMP_COM + COG_MAT_IMP_COM + STP_RATIO_IMP_COM + FAS_TOTAL_IMP_COM	IF COG_NB_MISSING_6TESTS_COM = 0	Number of cognitive test scores in impaired range; possible values are 0, 1, 2, 3, 4, 5 or 6

Derived Variable Specifications:

Value	Condition(s)	Description
0	COG_NMBR_IMP_6TESTS_COM ≤ 2	Not overall cognitively impaired
1	COG_NMBR_IMP_6TESTS_COM ≥ 3	Overall cognitive impairment is indicated
-77771	COG_NMBR_IMP_6TESTS_COM = missing	Unable to determine due to missing values

10. Cognitive Impairment on the Prospective Memory Event Task

Derived Variable Name: PMT_EVENT_IMP_COM

Description: A binary-valued variable that indicates whether the participant's prospective memory score on the event task falls in the lowest 5% of the neuro-healthy CLSA norming subsample. The cut-off value for impairment is the 5th percentile of the PMT_EVENT scores obtained from the CLSA English and French neuro-healthy norming subsamples stratified by sex (SEX_ASK_COM), education level (ED_UDR04_COM) and age group (AGE_GROUP_COM).

Based on: SEX_ASK_COM, ED_UDR04_COM, AGE_GROUP_COM, PMT_LANG_COM, PMT_EVENT_SCORE_COM

Derived Variable Specifications:

Value	Condition(s)	Description
0	SEX_ASK_COM = ('M', 'F') and ED_UDR04_COM = (1, 2, 3, 4) and AGE_GROUP_COM = (1, 2, 3, 4) and PMT_LANG_COM = ('en', 'fr') and PMT_EVENT_SCORE_COM ≥ cut-off value	Not impaired on PMT Event task
1	SEX_ASK_COM = ('M', 'F') and ED_UDR04_COM = (1, 2, 3, 4) and AGE_GROUP_COM = (1, 2, 3, 4) and PMT_LANG_COM = ('en', 'fr') and PMT_EVENT_SCORE_COM < cut-off value	Impaired on PMT Event task (in lowest 5% of healthy participants)
-77771	Missing any of the required variables	Unable to determine due to missing data

11. Cognitive Impairment on the Prospective Memory Time Task

Derived Variable Name: TMT_TIME_IMP_COM

Description: A binary-valued variable that indicates whether the participant’s prospective memory score in the time task falls in the lowest 5% of the neuro-healthy CLSA norming subsample. The cut-off value for impairment is based on the 5th percentile of the TMT_TIME scores obtained from the CLSA English and French neuro-healthy norming subsamples stratified by sex (SEX_ASK_COM), education level (ED_UDR04_COM) and age group (AGE_GROUP_COM).

Based on: SEX_ASK_COM, ED_UDR04_COM, AGE_GROUP_COM, TMT_LANG_COM, TMT_TIME_SCORE_COM

Derived Variable Specifications:

Value	Condition(s)	Description
0	SEX_ASK_COM = ('M', 'F') and ED_UDR04_COM = (1, 2, 3, 4) and AGE_GROUP_COM = (1, 2, 3, 4) and TMT_LANG_COM = ('en', 'fr') and TMT_TIME_SCORE_COM ≥ cut-off value	Not impaired on the TMT Time task
1	SEX_ASK_COM = ('M', 'F') and ED_UDR04_COM = (1, 2, 3, 4) and AGE_GROUP_COM = (1, 2, 3, 4) and TMT_LANG_COM = ('en', 'fr') and TMT_TIME_SCORE_COM < cut-off value	Impaired on TMT Time task (in lowest 5% of healthy participants)
-77771	Missing any of the required variables	Unable to determine due to missing data