**MESA MIND A Cognitive Testing & Domain Scores**

**Dataset:** MESA\_MINDA\_cog\_tests\_10032024

**Timeline**

MESA MIND A cognitive testing was administered from June 11, 2019 – February 8, 2022. Due to the effects of COVID-19, in-person testing was halted on March 20, 2020, and modified testing via telephone began on June 18, 2020. Testing via telephone continued through February 8, 2022.

**Overview of the testing procedure**

* Tests conducted differ slightly by language and mode of administration.
* While testing is available in English, Spanish, and Chinese, verbal administration was conducted in English, Spanish, Mandarin, or Cantonese based on participant preference.
* MIND A Testing was completed via three modes: in-person, telephone, and video.
	+ In-person (A) used complete test items
	+ Telephone (T) dropped visual items from CASI and the following tests: Digit Symbol Coding, Benson Figure, MoCA, and WRAT.
	+ Video (V) dropped visual items (e.g., Digit Symbol Coding, MoCA, and WRAT). Benson Figure was retained.
* Scores across modes of administration can be treated the same, however analyses should adjust for mode of administration (VISITCODEMA6C)

**Cognitive Tests available**

The cognitive tests administered include the Uniform Data Set v3 battery with the addition of QDRS, CASI, Digit Symbol Coding, RAVLT, and WRAT-5 Reading test.

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| **Cognitive Tests** | **In-person**  | **Telephone**  | **Video**  |
| **Cognitive Testing** | **Cognitive Testing** | **Video Cognitive Testing** |
| *Participant Interview* |   |   |   |
| Hearing assessment / instructions | NA | Yes | Yes |
| Montreal Cognitive Assessment (MoCA) | Yes | Removed | Removed |
| Wide Range Achievement Test (WRAT5) Word Reading subtest | Yes | Removed | Removed |
| Benson Complex Figure – Copy & Delayed Recall and Recognition | Yes | Removed | Yes |
| Digit Symbol Coding | Yes | Removed | Removed |
| Quick Dementia Rating System (QDRS) | Yes | Yes | Yes |
| Cognitive Abilities Screening Instrument (CASI) | Yes | Yes (non-visual items) | Yes |
| Rey Auditory Verbal Learning Test (RAVLT) - Immediate Recall | Yes | Yes | Yes |
| Number Span Forwards & Backwards | Yes | Yes | Yes |
| Trail Making Test | Yes | Oral Trails\*\* | Oral Trails\*\* |
| Geriatric Depression Scale (GDS-15) | Yes | Yes | Yes |
| Craft Story – Immediate Recall | Yes | Yes | Yes |
| Education, Medical Hx, Medications | Yes | Yes | Yes |
| RAVLT - Delay Recall & Recognition | Yes | Yes | Yes |
| Category Fluency (Animals & Vegetables) | Yes | Yes | Yes |
| Verbal Fluency (F&L) | Yes | Yes\* | Yes\* |
| Craft Story - Delay Recall | Yes | Yes | Yes |
| *Informant interview* |   |   |  |
| QDRS | Yes | Yes | Yes |
| Neuropsychiatric Inventory Questionnaire (NPI-Q) | Yes | Yes | Yes |
| Functional Activities Questionnaire (FAQ) | Yes | Yes | Yes |
| a WRAT-5 Reading Test was administered for English speaking participants only.\* Verbal Fluency test was included in MoCA (F only) for In-Person visits. For Telephone and Video visits, Verbal Fluency test was administered as an independent test (F & L) and scored separately. The scores for Telephone and Video tests were combined with In-Person tests into one score.\*\* Trail Making test was conducted for In-Person visits. For Telephone and Video visits, Oral Trail Making test was administered as an independent test and scored separately. The scores for Telephone and Video tests were combined with In-Person tests into one score. |

Generally, MESA cognitive variable names are harmonized with NACC Uniform Data Set v3.

For more information on the NACC Uniform Data Set v3 battery, please refer to:

* Coding Guidebook: <https://files.alz.washington.edu/documentation/uds3-ivp-guidebook.pdf>
* Data Element Dictionary: <https://files.alz.washington.edu/documentation/uds3-ivp-ded.pdf>

**Adjustments for Telephone CASI**

* CASI consists of 30 questions to assess global cognitive performance, scored 0-100.
* Telephone CASI dropped visual items (excluded question numbers: 18, 19, 20, 21, 23, 24, 25) and was rescored 0-77 points. Telephone scores have been prorated as a percent of 77 points to re-scale them as scores 0-100.
	+ See tCASI Documentation for calculation and validation details.

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| **Normalization Methods for Components of Each UDS Domain Score for MIND A Visits** |
|   | **White** | **AA** | **Hispanic / Latino** | **Chinese** |
| **MEMORY\_IMMED\_DOMAIN** |
| Craft Immediate | Sachs et al. 1 | Sachs et al. 1 | Marquine et al. 3 | Self-Norms |
| RAVLT Immediate | MOANS 2 | MOAANS 2 | Self-Norms | Self-Norms |
| **MEMORY\_DELAY\_DOMAIN** |
| Craft Delayed | Sachs et al. 1 | Sachs et al. 1 | Marquine et al. 3 | Self-Norms |
| Benson Figure delayed | Sachs et al. 1 | Sachs et al. 1 | Marquine et al. 3 | Self-Norms |
| RAVLT Delayed | MOANS 2 | MOAANS 2 | Self-Norms | Self-Norms |
| **LANG\_SEMANTIC\_DOMAIN** |
| Category Fluency: Animals | Sachs et al. 1 | Sachs et al. 1 | Marquine et al. 3 | Self-Norms |
| Category Fluency: Vegetables | Sachs et al. 1 | Sachs et al. 1 | Marquine et al. 3 | Self-Norms |
| **ATTN\_PROCESS\_DOMAIN** |
| Trailmaking A | Sachs et al. 1 | Sachs et al. 1 | Marquine et al. 3 | Self-Norms |
| Digit Span Forward | Sachs et al. 1 | Sachs et al. 1 | Marquine et al. 3 | Self-Norms |
| Digit Symbol Coding | WAIS 4 | WAIS 4 | English: WAIS 4, Spanish: WAIS v4 5 | Self-Norms |
| **EXECUTIVE\_DOMAIN** |
| Trailmaking B | Sachs et al. 1 | Sachs et al. 1 | Marquine et al. 3 | Self-Norms |
| Digit Span Backward | Sachs et al. 1 | Sachs et al. 1 | Marquine et al. 3 | Self-Norms |
| **VISUO\_DOMAIN** |
| Benson Figure Immediate | Sachs et al. 1 | Sachs et al. 1 | Marquine et al. 3 | Self-Norms |
| **PHONEMIC\_DOMAIN** |
| Verbal Fluency\* | Sachs et al. 1 | Sachs et al. 1 | Marquine et al. 3 | Self-Norms |
| \* Verbal Fluency test is administered differently across languages, using F for English and Chinese testing and P for Spanish testing. Scores were normed accordingly.  |
| 1 Sachs, B. C., Steenland, K., Zhao, L., Hughes, T. M., Weintraub, S., Dodge, H. H., Barnes, L. L., Craft, S., Parker, M. L., & Goldstein, F. C. (2020). Expanded Demographic Norms for Version 3 of the Alzheimer Disease Centers' Neuropsychological Test Battery in the Uniform Data Set. Alzheimer disease and associated disorders, 34(3), 191–197. https://doi.org/10.1097/WAD.0000000000000388 |
| 2 Lucas, J. A., Ivnik, R. J., Willis, F. B., Ferman, T. J., Smith, G. E., Parfitt, F. C., Petersen, R. C., & Graff-Radford, N. R. (2005). Mayo's Older African Americans Normative Studies: normative data for commonly used clinical neuropsychological measures. The Clinical neuropsychologist, 19(2), 162–183. https://doi.org/10.1080/13854040590945265 |
| 3 Marquine, Parks, Perales-Puchalt, González, Rosado-Bruno, North, Pieper, Werry, Kiselica, Chapman, Dodge, Gauthreaux, Kukull & Rascovsky (2023). Demographically-adjusted Normative Data among Latinos for the Version 3 of the Alzheimer Disease Centers’ Neuropsychological Test Battery in the Uniform Data Set. Alzheimer's & Dementia: The Journal of the Alzheimer's Association. |
| 4 Wechsler, D. (1997). Wechsler Adult Intelligence Scale--Third Edition (WAIS-III) [Database record]. APA PsycTests. https://doi.org/10.1037/t49755-000 |
| 5 Wechsler, D. (2014). WAIS-IV. Escala de inteligencia de Wechsler para adultos-IV. Manual de aplicación y corrección- Versión méxicana. Traducción al español por Editorial El Manual Moderno, S. A. de C. V. D. R. Traducido por M. C. Uribe Ferrari; coordinación de estandarización Facultad de Psicologia, Universidad Nacional Autónoma de México; análisis estadistico J. Zhu, Y. Meng, I. Martinez. J. L. Morales Saavedra & T. Uriza Gómez (Eds.). D. F., México: NCS Pearson, Inc. |

**Application of Self Norms**

**Self-Normalization of Test Scores for Chinese Participants**

* Determined the “norm” sample to be comprised of MIND A (n=133) and MIND B (n=120) Chinese participants who were cognitively normal at adjudication. We recognized that there are some repeats between MIND A and MIND B, but we are considering them as separate observations for sample size purposes. Total sample size used for norms is N=253, of which, N=101 tested in English.
* We then compared differences in raw test scores across languages (English vs Chinese).
* Though some differences were present, most test scores were not significantly different for English vs Chinese speakers. This allowed us to use the same standardization procedure for both languages without stratification.
* Use the means and standard deviations from the subset of participants who meet the criteria listed above (n=101) to calculate norms (z-scores) for each test for all Chinese participants.
	+ *Zscore = (score – mean) / stdev*, where *mean* and *stdev* refer to the mean and standard deviation of the raw scores of the Chinese ppts who were cognitively normal and tested in English
* Chinese normalization will be updated once official norms are available.

**Self-Normalization of AVLT Scores for Hispanic/Latino Participants**

* Determined the “norm” sample to be comprised of in-person MIND A (n=71) and MIND B(n=158) Hispanic participants who were cognitively normal at adjudication. We recognized that there are some repeats between MIND A and MIND B, but we considered them as separate observations for sample size purposes. Total sample size used for norms is N=229. Age ranges from 63 to 98 years.
* To better resemble the MOANS and MOAANS AVLT norms, we stratified by Age groups.
* We further stratified by language, as there may be differences in testing and scoring across English (70.3%) and Spanish (29.7%) speakers.
* Due to the small sample size for each 10-year increment of age among Spanish speakers, we only stratified age by “Below 75” (42.8%) and “75 and Older” (57.2%).
* Used the stratified means and standard deviations from the subset of participants who met the criteria listed above (n=229) to calculate norms (z-scores) for each AVLT score for all Hispanic/Latino participants.
	+ *Zscore = (score – mean) / stdev*, where *mean* and *stdev* refer to the mean and standard deviation of the stratified raw scores of the Hispanic/Latino ppts who were cognitively normal and tested in-person.

**Overview of the calculation procedure for domains**

* Individual test scores were normalized, using either Sachs Norms, MOANS, MOAANS, WAIS or Self-norming.
* Normalized scores were then averaged to create each corresponding domain score.

**General aspects of QC**

CASI Validity score (VALIDMA6C) was used as an indicator of validity across all cognitive testing, not limited to only CASI.

Steps taken to determine validity of tests:

1. CASI Score outliers were identified by 3 standard deviations above or below the mean.
2. Examined validity of CASI Score (VALIDMA6C) of lists of outliers.

1: VALID

2: PROB INVALID- POOR HEARING

3: PROB INVALID- POOR EYESIGHT

4: PROB INVALID- IMPAIRED MOTOR CONTROL

5: PROB INVALID- LANGUAGE BARRIER

6: PROB INVALID- IMPAIRED ALERTNESS AND ATTENTIVENESS

7: PROB INVALID- SIGNIFICANT PHYSICAL/MENTAL DISCOMFORT

8: PROB INVALID- OTHER REASONS

1. Any testing administration notes were examined to verify CASI validity.
2. If CASI validity and administration notes both fail to explain, examine case report forms.

**Validity Indicator**

Overall cognitive testing validity was summarized by the indicator, **COG\_VALIDMA6C**, having the following levels:

1: VALID

2: PROB INVALID- POOR HEARING

3: PROB INVALID- POOR EYESIGHT

4: PROB INVALID- IMPAIRED MOTOR CONTROL

5: PROB INVALID- LANGUAGE BARRIER

6: PROB INVALID- IMPAIRED ALERTNESS AND ATTENTIVENESS

7: PROB INVALID- SIGNIFICANT PHYSICAL/MENTAL DISCOMFORT

8: PROB INVALID- OTHER REASONS

9: CASI INVALID- N MISSING CASI COMPONENTS>3 AND / OR CASI SCORE≤20

**CASI**

CASI scores were considered valid if **all** the following are true:

* + VALIDMA6C = 1
	+ CASI Score > 20
	+ Number of missing components of CASI Test ≤ 3
	+ Testing administration notes did not suggest invalidity.

This is summarized by the variable: **COG\_VALIDMA6C = 1**

**Other Tests**

All other cognitive tests were considered valid if:

* + VALIDMA6C = 1
	+ Testing administration notes did not suggest invalidity.

This is summarized by the variable: **COG\_VALIDMA6C = 1 or 9**

**Exclusions & Recommendations:**

* For CASI, exclude if **COG\_VALIDMA6C ≠ 1**. For all other tests, exclude if **COG\_VALIDMA6C ≠ 1 or 9**.
* May additionally wish to exclude ICD Dementia cases.
	+ Variable names: **icddementia\_dh** (0/1) and **icddementia\_dhtt** (time to event) from the dataset: *mesaevdmntiathru[DATE]* [If available, David please enter date for follow-up time for icddementia\_dhtt corresponding to beginning of MIND A]
* Adjust analyses for mode of administration (**VISITCODEMA6C**).

| **Order** | **Variable** | **Variable Description** | **Value Labels** |
| --- | --- | --- | --- |
| 1 | IDNO | MESA PARTICIPANT ID |   |
| 2 | LANGMA6C | LANGUAGE OF ADMINISTRATION | 1: ENGLISH2: SPANISH3: CHINESE |
| 3 | VISITCODEMA6C | VISIT TYPE | A: IN-PERSONT: TELEPHONEV: VIDEO |
| 4 | D\_TESTINGMA6C | DATE OF TESTING |   |
| 5 | CASISUMMA6C | CASI: TOTAL COGNITIVE ASSESSMENT SCORE |   |
| 6 | COG\_VALIDMA6C | VALIDITY OF COGNITIVE TESTING SCORESFOR CASI, SCORES VALID IF = 1FOR ALL OTHER COGNITIVE TESTS, SCORES VALID IF = 1 OR 9 | 1: VALID2: PROB INVALID- POOR HEARING3: PROB INVALID- POOR EYESIGHT 4: PROB INVALID- IMPAIRED MOTOR CONTROL5: PROB INVALID- LANGUAGE BARRIER6: PROB INVALID- IMPAIRED ALERTNESS AND ATTENTIVENESS7: PROB INVALID- SIGNIFICANT PHYSICAL/MENTAL DISCOMFORT 8: PROB INVALID- OTHER REASONS9: N MISSING CASI COMPONENTS > 3 AND / OR CASI SCORE ≤ 20 |
| 7 | NMISSINGMA6C | NUMBER OF MISSING COMPONENTS OF CASI |   |
| 9 | CRAFTDREMA6C | CRAFT STORY 21 RECALL (DELAYED) — TOTAL STORY UNITS RECALLED, PARAPHRASE SCORING |   |
| 10 | CRAFTDVRMA6C | CRAFT STORY 21 RECALL (DELAYED) — TOTAL STORY UNITS RECALLED, VERBATIM SCORING |   |
| 11 | CRAFTURSMA6C | CRAFT STORY 21 RECALL (IMMEDIATE) — TOTAL STORY UNITS RECALLED, PARAPHRASE SCORING |   |
| 12 | CRAFTVRSMA6C | CRAFT STORY 21 RECALL (IMMEDIATE) — TOTAL STORY UNITS RECALLED, VERBATIM SCORING |   |
| 13 | DGTBCKMA6C | TEST BACKWARD - TOTAL DIGIT SPAN SCORE |   |
| 14 | DGTFORMA6C | TEST FORWARD - TOTAL DIGIT SPAN SCORE |   |
| 15 | DSYMSCRMA6C | DIGIT SYMBOL SCORE |   |
| 16 | MOCATOTSMA6C | MOCA TOTAL RAW SCORE — UNCORRECTED |   |
| 17 | TRAILAMA6C | TRAIL MAKING TEST PART A — TOTAL NUMBER OF SECONDS TO COMPLETE |   |
| 18 | TRAILBMA6C | TRAIL MAKING TEST PART B — TOTAL NUMBER OF SECONDS TO COMPLETE |   |
| 19 | UDSBENTCMA6C | TOTAL SCORE FOR COPY OF BENSON FIGURE |   |
| 20 | UDSBENTDMA6C | TOTAL SCORE FOR 10- TO 15-MINUTE DELAYED DRAWING OF BENSON FIGURE |   |
| 21 | UDSVERFCMA6C | NUMBER OF CORRECT F-WORDS GENERATED IN 1 MINUTE |   |
| 22 | VEGMA6C | VEGETABLE — TOTAL NUMBER OF VEGETABLES NAMED IN 60 SECONDS |   |
| 23 | ANIMALSMA6C | ANIMALS — TOTAL NUMBER OF ANIMALS NAMED IN 60 SECONDS |   |
| 24 | AVLT\_DELAYED\_TOTALMA6C | AVLT DELAYED TOTAL |   |
| 25 | AVLT\_T1\_TOTALMA6C | AVLT T1 TOTAL |   |
| 26 | AVLT\_LOTMA6C | AVLT LOT |   |
| 27 | AVLT\_T6\_TOTALMA6C | AVLT T6 TOTAL |   |
| 28 | AVLT\_TOTAL\_CORRECTMA6C | AVLT RECOGNITION TOTAL CORRECT |   |
| 29 | AVLT\_LISTB\_TOTALMA6C | AVLT LIST B TOTAL |   |
| 30 | WRAT5MA6C | WRAT WORD READING TOTAL |   |
| 31 | WRAT5\_GRADE\_EQUIVMA6C | WRAT WORD READING GRADE EQUIVALENT |   |
| 32 | GDSMA6C | TOTAL GDS SCORE |   |
| 33 | QDRS\_TOTAL\_PARTICIPANTMA6C | QDRS PARTICIPANT TOTAL |   |
| 34 | QDRS\_TOTAL\_INFORMANTMA6C | QDRS INFORMANT TOTAL |   |
| 35 | NPIQ\_TOTALMA6C | NEUROPSYCHIATRIC INVENTORY QUESTIONNAIRE (NPI-Q) |   |
| 36 | FAQ\_SCOREMA6C | FUNCTIONAL ACTIVITIES QUESTIONNAIRE (FAQ) TOTAL |   |
| 37 | MEMORY\_IMMED\_DOMAINMA6C | MEMORY IMMEDIATE DOMAIN Z-SCORE |   |
| 38 | MEMORY\_DELAY\_DOMAINMA6C | MEMORY DELAYED DOMAIN Z-SCORE |   |
| 39 | LANG\_SEMANTIC\_DOMAINMA6C | LANGUAGE / SEMANTIC FLUENCY DOMAIN Z-SCORE |   |
| 40 | PHONEMIC\_DOMAINMA6C | PHONEMIC DOMAIN Z-SCORE |   |
| 41 | ATTN\_PROCESS\_DOMAINMA6C | ATTENTION / PROCESSING SPEED DOMAIN Z-SCORE |   |
| 42 | EXECUTIVE\_DOMAINMA6C | EXECUTIVE DOMAIN Z-SCORE  |   |
| 43 | VISUO\_DOMAINMA6C | VISUOSPATIAL DOMAIN Z-SCORE |   |
| 44 | LANG\_PHONEMIC\_DOMAINMA6C | LANGUAGE AND PHONEMIC DOMAIN Z-SCORE |  |