

Open-Source Normative Calculator and Interactive Longitudinal Data Visualization Tool for the NACC UDS Neuropsychological Battery



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KEYWORDS — Normative Models, Open Source Software, Interactive Dashboard

I. INTRODUCTION

Normative cognitive test scores adjusting for demographic factors are central to determining if individual performance is consistent with a neurocognitive disorder.

Alzheimer’s Disease Research Centers (ADRC) employ a fixed cognitive battery, although normative samples and methods vary across sites which can impact diagnostic impressions.

Cohesively evaluating longitudinal cognitive trajectories, often spanning multiple study visits, poses additional interpretive challenges for neuropsychologists serving on consensus panels.

Using open-source tools, we developed an automated normative data calculator and data visualization tool for the neuropsychological battery of the National Alzheimer’s Coordinating Center, Uniform Dataset (NACC-UDS).

II. OUR APPROACH

i. The Goals

Streamline the process of aggregating, standardizing, and visualizing cognitive test data using open-source tools within the statistical programming language of R.

Provide a clean, automated, and easy-to-use user interface to aide clinical interpretation of cognitive data.

ii. The Ideas

A flexible framework for standarization: this helps shorten the path from development of new methods to practical application.

User-friendly and easy-to-use dashboard that

- includes customizable user settings. Program can easily adapt to calculating normative data using different approaches, samples, and covariates (Age, sex, education, race).
- is extendable. Different sites have different needs.
- fit nicely in already established workflows. Summary sheets to be exported as PDFs for detailed records.

iii. The Results

{ntrs} helps standardize neuropsychological test scores using normative lookup tables and regression-based models. The following normative methods are readily available:

- NACC 2017 Norms Calculator (regression based; published by Weintraub et al. (2018) with online calculator available at <https://files.alz.washington.edu/documentation/uds3-norms-calculator.xlsx>)
- NACC 2020 Data Freeze (mean/std; <https://files.alz.washington.edu/documentation/uds3-means.pdf>)
- Updated models based on the NACC June 2025 data freeze (both mean/std, and regression based)
- Regression based T-scores from Stricker et al. (2021) (MOANS population; available in extension package {ntrsTscores})

III. SCREENSHOTS

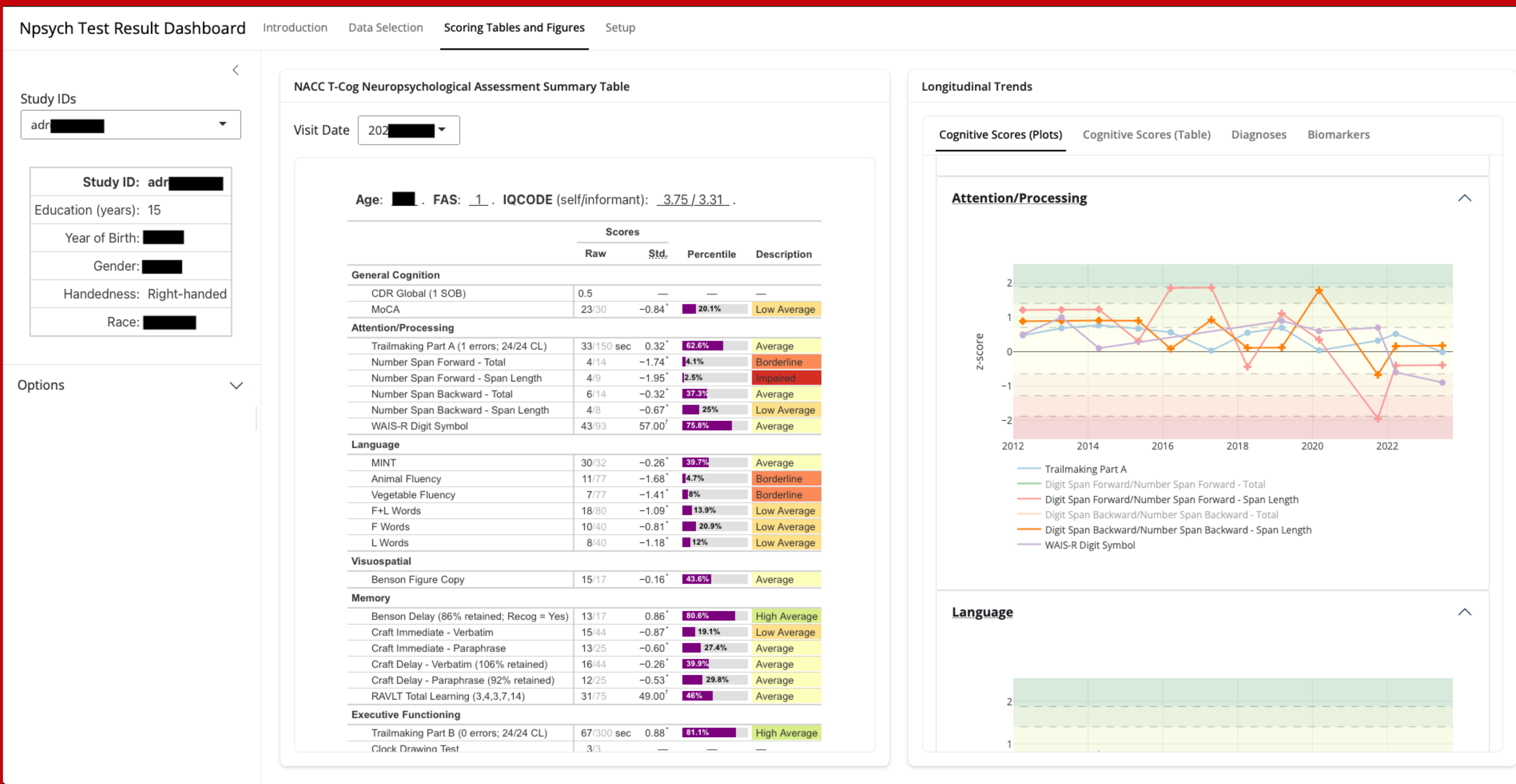


Figure 1: Main presentation: demographics table (left), standardized scores (middle), longitudinal trends (right).

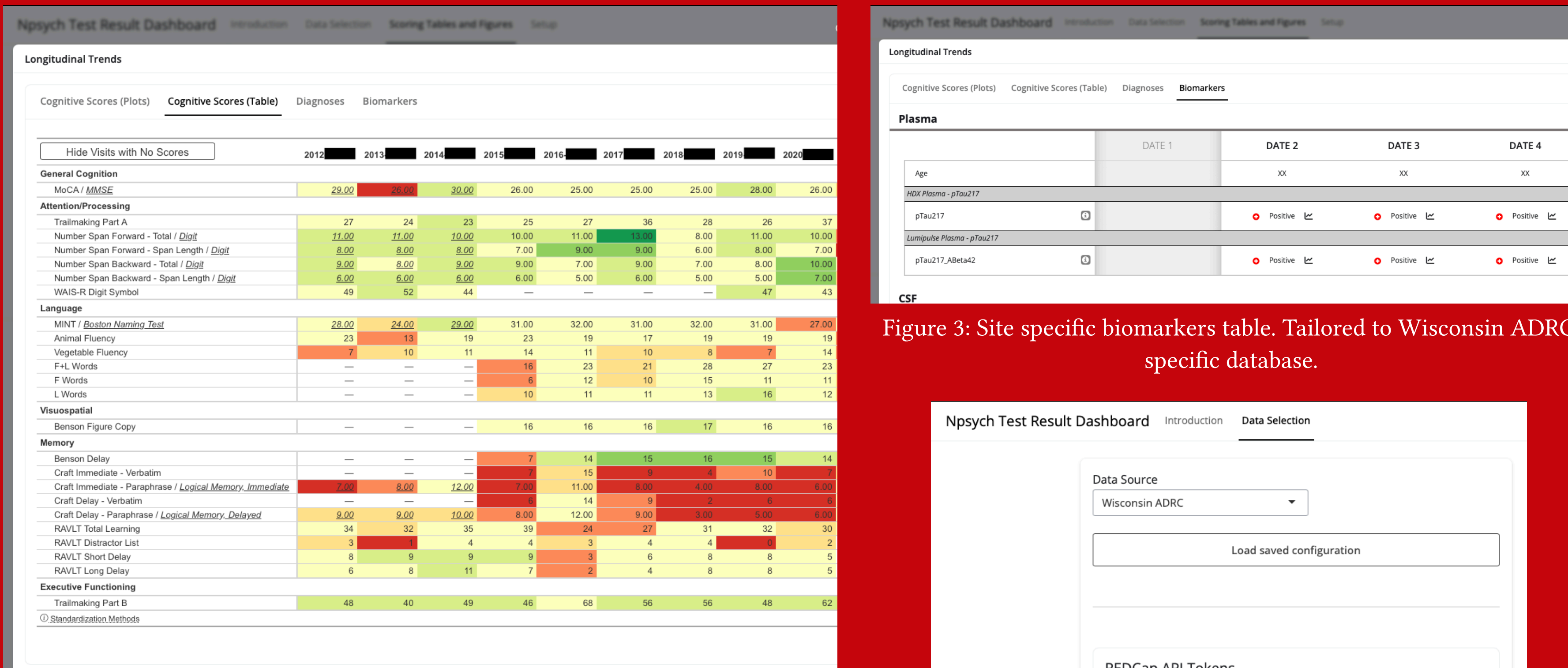


Figure 2: Raw scores presented longitudinally.

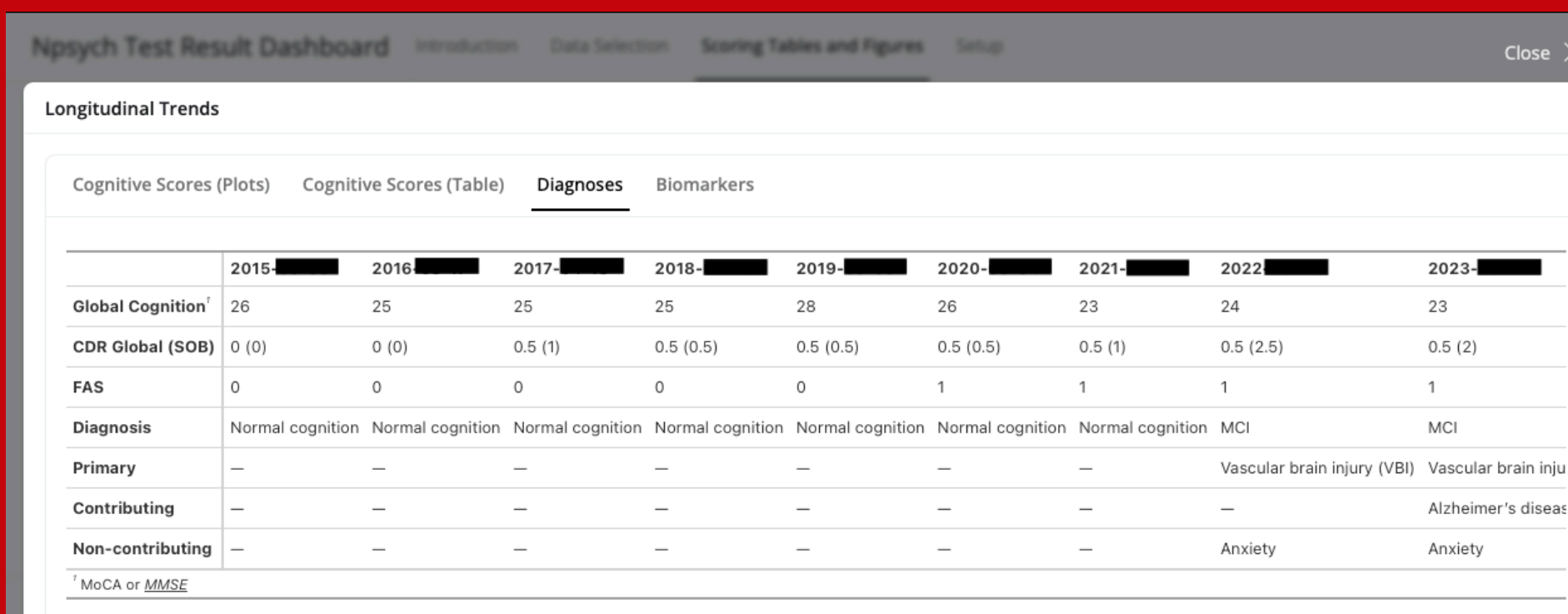


Figure 4: Diagnosis relevant variables presented longitudinally.

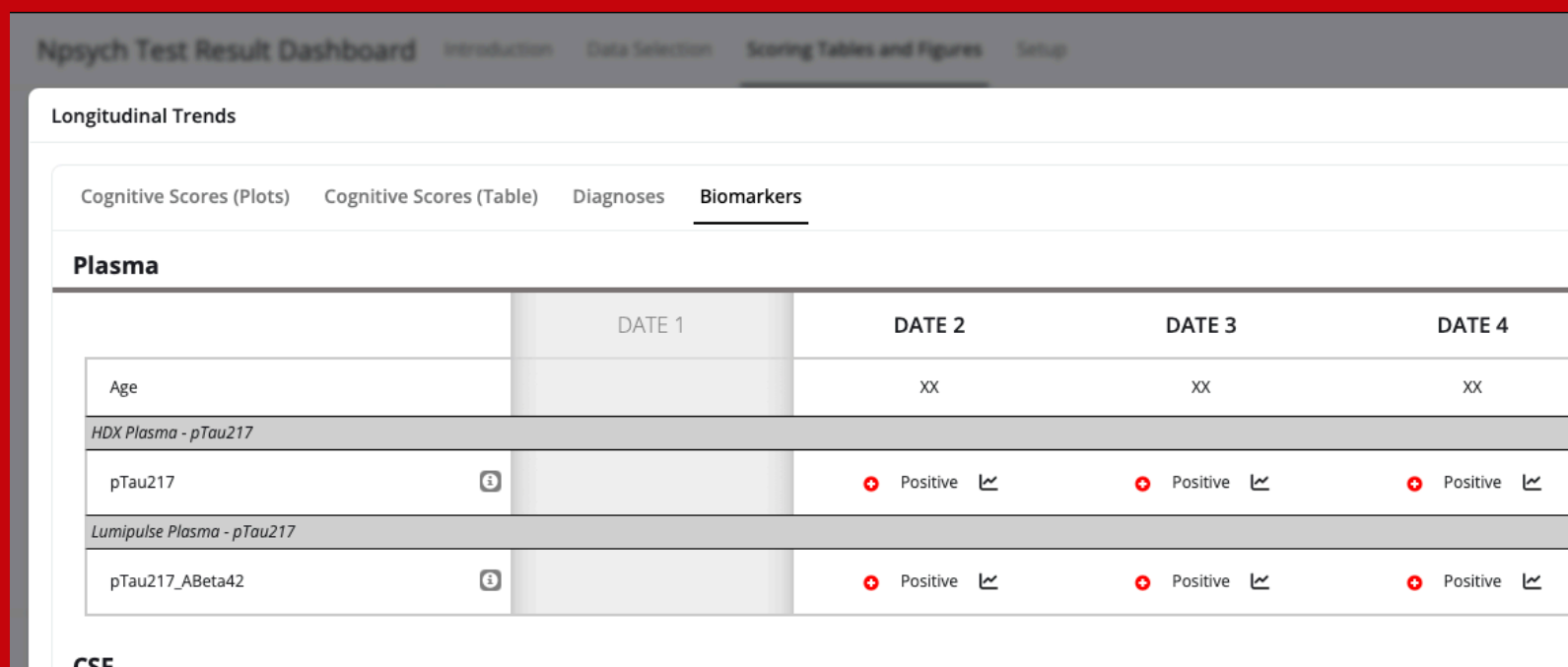


Figure 3: Site specific biomarkers table. Tailored to Wisconsin ADRC specific database.

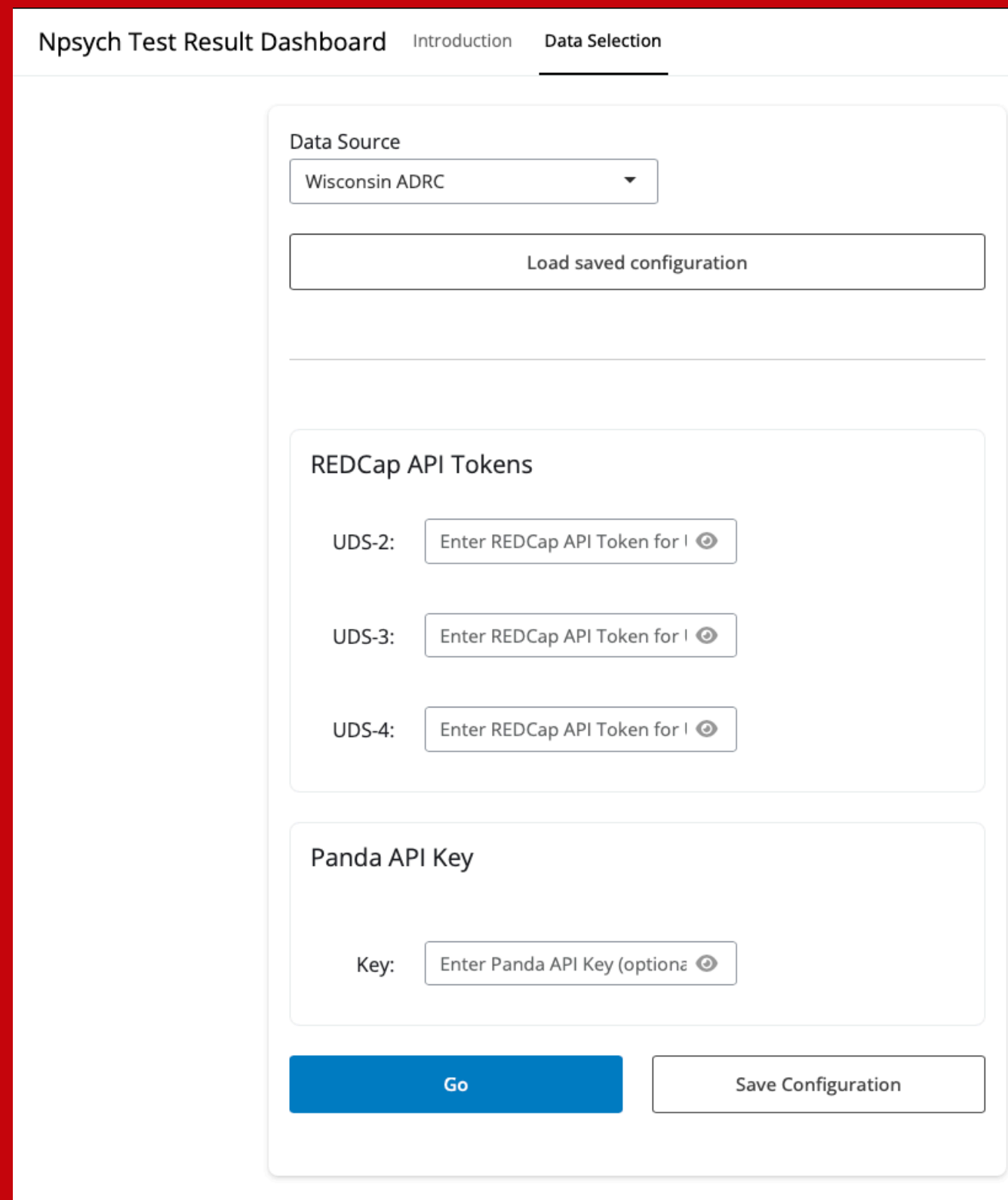


Figure 5: Wisconsin ADRC specific data input.

iii. The Results (cont.)

{ntrd} ships the dashboard for visual presentation (see figures). It allows for importing CSV files (assuming NACC data formatting), and can be extended with custom site-specific data import options, and custom tables and figures.

IV. CONCLUSIONS

Utilizing open-source tools, we developed an automated program to streamline the process of standardizing NACC-UDS cognitive test data and for visualizing longitudinal trajectories.

This freely available application was built to emphasize ease-of-use, allowing clinicians to seamlessly move between patients and study visits with no manual data preparation required.

Widespread adoption of this tool across ADRC sites stands to promote consistent data normalization standards, ultimately improving the reliability of clinical interpretation and resultant diagnostic outcomes in the NACC database.

The vision is to create a collaborative effort that builds on this foundation. Lessons learned across sites can inform a set of reasonable default standardization methods, and improve how data are presented to best assist in the diagnostic process. For example, the inclusion of reliable change scores is being considered for future releases.

Future Directions

Additional normative methods, including non-linear z-scores (Kornak et al., 2019)

Reliable change scores are being considered for future releases.

An online calculator for manual data entry in real time is also being considered.

Limitations

While the tool is designed around standardized NACC data definitions and formatting, on-site adaptation is required.

LINKS

{ntrs} <https://rmtrane.github.io/ntrs>
{ntrd} <https://rmtrane.github.io/ntrd>
{ntrsTscores} <https://rmtrane.github.io/ntrsTscores>

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