NATIONAL HEALTH AND AGING TRENDS STUDY (NHATS)

COGSTATE USER GUIDE

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Beta File Version

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Overview

This User Guide describes the cognitive data collected in Round 11 (2021) of the National Health and Aging Trends Study (NHATS) using a brief tablet-based protocol from Cogstate. In Round 11, all NHATS participants who were eligible for a Sample Person (SP) interview were eligible to complete three Cogstate activities: a) detecting if a playing card is turned over, b) identifying if the card is red, and c) reporting if the card matches the previous card (one card back).

The NHATS Cogstate data is included in the NHATS Tablet Activities File, available to registered users as a public release file from www.nhats.org. This User Guide provides background on each of the tests, details on NHATS collection methodology, available variables, and a brief overview of how to conduct weighted analyses that account for NHATS' complex survey design.

Background

By adding Cogstate testing, NHATS' objectives were to broaden cognitive domains and items in the NHATS cognition battery and to enhance detection of cognitive decline. The three Cogstate activities included in NHATS were designed to expand domains to include psychomotor function (detection), visual attention (identification) and working memory (one card back). Participants completed the three playing card activities on a tablet, each with multiple trials. For each activity, reaction time and accuracy were recorded. For detection and identification, the primary outcome of interest is speed, with lower scores indicating better performance. For one card back, the primary outcome of interest is accuracy, with higher scores indicating better performance.

Performance on the instrument differentiates cognitively healthy from impaired older adults (Racine et al. 2016; Lim et al. 2012; Hammers et al. 2012), demonstrates good test-retest reliability (Fredrickson et al. 2010; Collie et al. 2003), correlates with paper-based tests (Maruff et al. 2009; de Jager et al. 2009), and is feasible in community-based settings. It is also appropriate for use with older people with less education and those with little computer experience (Mielke et al. 2015). The Cogstate assessments also have an advantage over some paper tests because it does not require literacy or numeracy skills or interviewer scoring of performance.

NHATS Cogstate Pilot Study

NHATS incorporated an experimental pilot study into Round 8 (N=450 participants) to evaluate the field protocols and assess the impact of completing a full practice session. Participants were randomly assigned to have a full practice session with all activities prior to test administration, or to have only the test administration without a full practice session. For both the practice and actual tests, a brief demo (with a short practice) was provided immediately prior to each activity. Four activities were included in the pilot: detection, identification, one card learning (have they ever seen the card), one card back.

We found high participation (94%) levels and mean scores that aligned well with prior studies (Mielke et al. 2015). The group that was assigned the full practice session was more likely to have missing data on the tests (14.2% vs. 4.6%), with nearly all missing cases breaking off after the practice session but before the tests began. Among those that completed the tests, those that practiced had similar mean scores on detection, identification, and one card learning with those who did not practice. Those who practiced had slightly higher scores than those who didn't practice on the one card back test accuracy (1.28 vs. 1.23; p=.03). Adjusting for imbalances between the experimental and control group with respect to age, education and dementia classification, and adjusting for the higher missing rate among those who practiced, the difference on the one card back test accuracy narrowed to 0.03 (p=.22).

Based on these pilot findings, NHATS piloted three tests in Round 9, detection, identification, and one card back and the full practice session was eliminated. The one card learning was dropped to address time limits on the survey. This 3-test protocol took approximately 12 minutes to administer and was adopted in Round 11.

Data Collection Protocol

A generation 8 iPad running iOS 13.0 was loaded with Cogstate V7.5.17. Interviewers set up for the activity by launching the Cogstate App, creating a subject profile, and then seating the SP in front of the tablet with a clear view of the screen, preferably with the tablet on a table where they could comfortably reach the screen. Interviewers first described the screen and asked the respondent to practice pressing the YES and NO buttons. They then explained that there were three activities with pictures of playing cards and that there would be a short practice before each activity. For each activity, the interviewer read aloud the instructions on the screen, asked the SP to press START when ready, and monitored progress during the activity. Instructions for each activity are provided below:

Has the Card Turned Over? [Detection]
You are now going to do a (practice/test). As soon as the card turns face up: Press YES. Go as fast as you can and try not to make any mistakes. If you press YES before a card turns face up, you will hear an error sound.

Is the Card Red? [Identification]
You are now going to do a (practice/test). As soon as the card turns face up: Press YES if it is red. Press NO if it is black. Go as fast as you can and try not to make any mistakes. When you make a mistake, you will hear an error sound.

Is this Card the Same as the Previous Card? [One Card Back]
You are now going to do a (practice/test). As soon as the card turns face up: Press YES if it is the same as the card you just saw. Press NO if it is not the same as the card you just saw. Go as fast as you can and try not to make any mistakes. When you make a mistake, you will hear an error sound. Press NO when you see the first card turn face up.

Interviewers also noted in the CB section of the CAPI whether Cogstate was attempted and if not, the reason. Non-identifiable results were transmitted to Cogstate where data were processed and files were made available for download by NHATS staff at Westat.

Variables

Information about collection of the Cogstate measures along with results are included in the Tablet Activities File. Variable names in this file follow NHATS' standard conventions. Variables from the CB CAPI section and from Cogstate begin with "cb", followed by the round number, and stem that briefly describes the item. The following table summarizes variables by source and type of activity.

Source	Detection	Identification	One Card Back
Cogstate			
Speed of Performance[1]	cb#detspeed	cb#idnspeed	cb#onbspeed
Consistency of Performance[1]	cb#detstdev	cb#idnstdev	cb#onbstdev
Accuracy of Performance[2]	cb#detacc	cb#idnacc	cb#onbacc
Count of correct responses	cb#detcorr	cb#idncorr	cb#onbcorr
Count of errors	cb#deterr	cb#idnerr	cb#onberr
Count of correct responses plus errors	cb#detpres	cb#idnpres	cb#onbpres
Count of stimuli	cb#detstim	cb#idnstim	cb#onbstim
Activity completed[3]	cb#detcomp	cb#idncomp	cb#onbcomp
Activity met integrity criteria[4]	cb#detinteg	cb#idninteg	cb#onbinteg
CB CAPI			
Refused	cb#cogintro		
Attempted	cb#cognition		
Reason not attempted	cb#cogrsn1-cg#cogrsn6		

[1]Mean and standard deviation of the log10 transformed reaction times for correct responses, reported in log10 milliseconds as a number with up to 5 decimal places

[2]Arcsine square root proportion correct, reported as number with up to 5 decimal places

[3]Indicates whether a sufficient number of trials was completed (count of correct responses plus errors ≥27/35 for detection, ≥23/30 for identification and ≥24/31 for one card back) to calculate speed and accuracy. 1=Yes, met completion criteria; 2=No, did not meet completion criteria. Administrations that did not meet completion criteria are set to missing values for integrity, speed and accuracy performance measures.

[4]Indicates whether a subject performed according to *a priori* standards set by the Cogstate Science Team. Yes, met integrity criteria; 2=No, did not meet integrity criteria. Integrity is calculated only when the completion criteria are met. Cogstate suggests that a sensitivity analysis be run with test data integrity failures excluded if

the percentage failing to meet the criteria is >10%. In R11 NHATS the unweighted percentages (among those with test data) are below this threshold [1.6% (detection), 4.0% (identification), 5.3% (one card back)].

Missing data

For the Cogstate battery, we have created a derived variable that indicates why data are missing. The variable (cb11dcogbatm) has 6 values:

1= Deceased, original nursing home (r#dresid=6, 8)
2=No SP interview (r#dresid=3,5,7)
3=No Part 2 SP interview
4=SP refused or did not attempt Cogstate battery
5=No Cogstate data, other
6=Not missing

Using NHATS Weights and Design Variables in Analyses

The Cogstate data are designed to be nationally representative of Medicare beneficiaries (e.g. in 2021, ages 71 and older). To make statements that are generalizable to this population, the data must be weighted and design variables must also be used to account for NHATS' complex survey design. Details about accounting for NHATS' complex survey design features can be found in Freedman et al. (2022) available at www.nhats.org.

The weights and design variables for the Tablet Activities File are found on the SP file from the same year. To perform weighted analysis, the Tablet Activities File must be **merged** with the NHATS SP file for the same year using the identifier on both files, "**spid**".

Using Round 11 as an example, SAS, Stata and R code for merging and running weighted analyses with vision and hearing data are shown below.

Stata Commands. In Stata, users should specify the following svyset command for Round 11.

```
*merge Tablet Activities file with NHATS SP file
use "[location]/NHATS_Round_11B_SP_File.dta", clear
merge 1:1 spid using "[location]/NHATS_Round_11B_Activities_File.dta"

*set survey design for weighted analysis
svyset w11varunit [pweight=w11anfinwgt0], strata(w11varstrat)
svy: [stata procedures]
```

SAS Commands.

```
libname nhats11 "[NHATS round 11 data file location]";
```

```
data newname;
        merge  nhats11.NHATS_Round_11B_SP_File
                nhats11.NHATS_Round_11B_Activities_File;
        by spid;
run;


[SAS procedure];
weight w11anfinwgt0;
cluster w11varunit;
strata w11varstrat;
[model or other statement];
run;
```

R Commands.

```
newname <- merge(data frame for NHATS_Round_11B_SP_File, data frame for
NHATS_Round_11B_Activities_File, by="spid", all.x = TRUE)   #all.x = TRUE keeps all
observations from the Round 11 NHATS SP file


library(survey) #need this line only once per session
nhats.dsgn <- svydesign(id=~w11varunit, strata=~w11varstrat, weights=~w11anfinwgt0,
data = newname, nest=TRUE)
[model or other statement]
```

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