Health and Retirement Study
Imputation of Cognitive Functioning Measures:
1992 – 2020

Data Description

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Contents

Background

Along with physical decline, decline in cognitive functioning is a hallmark of aging and predictive of mortality. Many studies have demonstrated age differences in cognition, particularly in its processing capabilities (Salthouse, 1999). Declining cognitive functioning, in turn, is a likely factor in the development of functional impairment and disability. Cognitive functioning is also likely to impact one's ability to work and play a role in retirement, particularly in the modern labor market which increasingly consists of jobs that require cognitive abilities and competence. At the same time, there is evidence that despite decline in certain dimensions of cognitive functioning, older adults continue to perform well in everyday life situations such as work or health behaviors (Park, 1999). The implications of cognitive functioning and its changes for people's daily lives as they age are complex and in need of additional research to further our understanding. As a result, cognitive functioning is a critical dimension for conceptualization and measurement in the HRS study.

The design of the HRS study posed some methodological complexities for measurement of cognitive functioning, which necessitated appropriate adaptations of the standard tests. First, because of the mixed telephone and face-to-face interview modes, the HRS cognitive measures exclude nonverbal tests such as those measuring visual perception, memory, or psychomotor functioning, which cannot be administered over the telephone. Second, in a truly representative sample, some sampled respondents cannot participate in the interview because of physical or cognitive problems. Therefore, HRS obtained proxy interviews for participants who were unable to self-respond to the interview. Because the cognitive performance tests could not be conducted with a proxy respondent, a different set of measures was used in the proxy interview to assess the respondent's present cognitive status and change in status between waves. This report only pertains to cognitive tasks performed by self-respondents.

The HRS measures cognition in terms of episodic memory, mental status, and vocabulary (McArdle, Fisher, & Kadlec, 2007) among self-respondents. What follows is a list of these various cognitive functioning measures. More detail concerning these measures is available in the cognitive functioning user guide by Ofstedal, Fisher, and Herzog available on the HRS website at <http://hrsonline.isr.umich.edu/sitedocs/userg/dr-006.pdf>. Table 1 provides a concordance table listing which questions were asked in which wave. For more detail regarding exact question wording, skip patterns, and response coding, refer to the questionnaires and codebooks available on the HRS website: http://hrsonline.isr.umich.edu/ More recently the HRS has added measures of numeracy (numerical ability), quantitative reasoning, and verbal reasoning. Those measures are not included in this file.

Table 1. Cognition Questions Asked in HRS: Self-respondents

Question	W1 HRS92	W2 AHD93	W2 HRS 94	W3 AHD 95	W3 HRS 96	W4 HRS98	W5 HRS00	W6 HRS 02	W7 HRS 04	W8 HRS 06
Self-rated memory	L1	C1	C1	C1, M10-1	C1	C1	C1	HD101	JD101	KD101
Memory compared to 2 years ago/last interview	L2	C2	C2	C2, M10-2	C2	C2	C2	HD102	JD102	KD102
Immediate word recall	L4 (20)	C3 (10)	C3-4 (20)	C3-4, M10-3	C3-4 (10)	C3-4 (10)	C3-4 (10)	HD182M1-HD182M10	JD182M1-JD182M10	KD182M1-KD182M10
Delayed word recall	L17	C12	C19	C12, M10-12	C12	C8	C8	HD183M1-HD183M10	JD183M1-JD183M10	KD183M1-KD183M10
Date (mo/day/yr)	-	C5a-c	-	C5a-c, M10-5	C5a-c	C9a-c (65+)	C9a-c	HD151-HD153	JD151-JD153	KD151-KD153
Day of week	-	C5d	-	C5d, M10-5	C5d	C9d (65+)	C9d	HD154	JD154	KD154
Backwards count (20)	-	C6	-	C6, M10-6	C6	C6c C6f	C6c C6f	HD124, HD129	JD124, JD124a, JD129	KD124, KD124a, KD129
Backwards count (86)	-	-	-	C6a, M10-6a	C6a	C6j C6n	C6j C6n	HD134, HD139	-	-
Word recognition										
Scissors	-	C7	-	C7, M10-7	C7	C10 (65+)	C10	HD155	JD155	KD155
Cactus	-	C8	-	C8, M10-8	C8	C11 (65+)	C11	HD156	JD156	KD156
President	-	C9	-	C9, M10-9	C9	C12 (65+)	C12	HD157	JD157	KD157
Vice-president	-	C10	-	C10, M10-10	C10	C12a (65+)	C12a	HD158	JD158	KD158
Serial 7's	-	C11a-e	-	C11a-e, M10-11	C11a-e	C7a-e	C7a-e	HD142-HD146	JD142-JD146	KD142-KD146
Vocabulary	-	-	-	C13, M10	-	C13a-j (65+)	C13	HD161-HD169	JD161-JD169	KD161-KD169

Table 1 (cont.) Cognition Questions Asked in HRS: Self-respondents

Question	W9 HRS 08	W10 HRS 10	W11 HRS 12	W12 HRS 14	W13 HRS 16	W14 HRS 18	W15 HRS 20
Self-rated memory	LD101	MD101	ND101	OD101	PD101	QD101	RD101
Memory compared to 2 years ago/last interview	LD102	MD102	ND102	OD102	PD102	QD102	RD102
Immediate word recall	LD182M1- LD182M10	MD182M1- MD182M10	ND182M1- ND182M10	OD182M1- OD182M10	PD182M1- PD182M10	QD182M1- QD182M10 (FTF/TEL) QD182WM1- QD182WM10 (WEB)	RD182M1- RD182M10 (FTF/TEL) RD182WM1- RD182WM10 (WEB)
Delayed word recall	LD183M1- LD183M10	MD183M1- MD183M10	ND183M1- ND183M10	OD183M1- OD183M10	PD183M1- PD183M10	QD183M1- QD183M10 (FTF/TEL) QD183WM1- QD183WM10 (WEB)	RD183M1- RD183M10 (FTF/TEL) RD183WM1- RD183WM10 (WEB)
Date (mo/day/yr)	LD151- LD153	MD151- MD153	ND151- ND153	OD151- OD153	PD151- PD153	QD151-QD153	RD151-RD153
Day of week	LD154	MD154	ND154	OD154	PD154	QD154	RD154
Backwards count (20)	LD124, LD124a, LD129	MD124, MD129	ND124, ND129	OD124, OD129	PD124, PD129	QD124, QD129 (FTF/TEL ONLY)	RD124, RD129 (FTF/TEL ONLY)
Backwards count (86)	-	MD134, MD139	ND134, ND139	-	-	-	-
Object naming							
Scissors	LD155	MD155	ND155	OD155	PD155	QD155	RD155
Cactus	LD156	MD156	ND156	OD156	PD156	QD156	RD156
President	LD157	MD157	ND157	OD157	PD157	QD157	RD157
Vice-president	LD158	MD158	ND158	OD158	PD158	QD158	RD158
Serial 7's	LD142- LD146	MD142- MD146	ND142- ND146	OD142- OD146	PD142- PD146	QD142-QD146	RD142-RD146
Vocabulary	LD161- LD169	MD161- MD169	ND161- ND169	OD161- OD169	PD161- PD169	QD161-QD169	RD161-RD169

Mode

Starting in 2018, HRS offers some households web mode as their initial option for the core survey. These are households were selected from households in which all respondents indicated regular internet use in the prior wave. In the cognitive functioning imputation file, items for web cases include self-rated memory, self-rated memory compared to past, immediate and delayed word recall, serial 7's, and backward count from 20. Consistent with the core cognition data files from 2018 forward, immediate and delayed word recall are released in separate variables by mode in the cognitive functioning imputation file: RwIMRC and RwDLRC (FTF/TEL), and RwIMRCW and RwDLRCW (WEB). Mode indicators can be found in the Tracker file (xWEBCONTROL), the HRS core cognition (section D) data file (xDMODE), and the cognitive functioning imputation file (RwCOGMODE). For more detail regarding differences by mode of administration, refer to the questionnaires and codebooks available on the HRS website: http://hrsonline.isr.umich.edu/

Measures

This report only pertains to cognitive tasks performed by self-respondents. In other words, proxy measures were not imputed, and cognition scores were not imputed for interviews completed with a proxy reporter.

Memory

Two questions were asked about respondents' self-perceptions about memory and memory change during the past two years. Episodic memory was assessed using two word list recall tasks (immediate free-recall and delayed free recall).

Self-rated Memory (present)

HRS – 92 & 94
"How would you rate your ability to think quickly at the present time?"
"Would you say it is excellent, very good, good, fair, or poor?"

All Other Waves
"How would you rate your memory at the present time?"
"Would you say it is excellent, very good, good, fair, or poor?"

Scoring
Values range from 1-5 and are scaled such that higher values represent poorer memory (1=excellent and 5=poor memory). This is the reverse of the scoring for other cognitive tests.

Self-rated Memory (compared to past)

Values range from 1-3 and are scaled such that higher values represent poorer memory (1=better; 2=same; 3=worse). This is the reverse of the scoring for other cognitive tests.

HRS – 92 & 94
"Compared with 2 years ago, how would you rate your ability to think quickly? Would you say it is much better now, somewhat better now, about the same, somewhat worse, or much worse than it was then?"

All Other Waves
"Compared with (previous wave interview month-year/ two years ago), would you say your memory is better now, about the same, or worse now than it was then?"

Scoring
Values range from 1-3 and are scaled such that higher values represent poorer memory, (i.e., the reverse of the scoring compared to other cognitive tests).

Immediate Word Recall

HRS – 92 & 94
The interviewer read a list of 20 nouns (e.g., lake, car, army, etc.) to the respondent, and asked the respondent to recall as many words as possible from the list in any order.

All Other Waves
The immediate recall task remained the same as in HRS 92 and 94, except the total number of words read to respondents was reduced from 20 to 10 and the specific words used were changed. Specifically, the interviewer read one of four possible lists of 10 nouns to the respondent. The lists did not overlap in word content. In addition, the initial list was randomly assigned to the respondent, although the assignment was made longitudinally such that each respondent was assigned a different set of words in each of four successive waves of data collection. The assignment was also made so that two respondents in the same household (i.e., spouses or partners of one another) were not assigned the same set of words in the same or adjacent waves.

Web mode – 2018 forward
For web administration, the words were displayed one at a time on the respondent's screen. After the presentation of all 10 words, respondents were directed to type as many words as they can recall. Incorrect typed responses were reviewed by staff and misspellings that plausibly represented the correct word were coded as correct. In order for a misspelling to be coded as correct, the response had to plainly map to one of the presented words and not be a word in standard written English. For example, "hous" would be a correct response for "house", while "hose" would be scored as incorrect. The need to evaluate misspellings is infrequent. In the 2018 web-administration of the immediate and delayed word recall tasks, 61 misspellings were evaluated, with 22 judged to be correct responses.

Scoring
Count of number of words that were recalled correctly. Count ranges from 0-10 for all waves except HRS 92 & 94, in which the count ranges from 0-20.

Delayed Word Recall

After approximately 5 minutes of asking other survey questions (e.g., depression, and cognition items including backwards count, and serial 7's) the respondent was asked to recall the nouns previously presented as part of the immediate recall task. Note the differences in word list administration between HRS 92 and 94 and all other HRS/AHEAD waves as described under *immediate word recall*. The questions asked between administration of the immediate word recall and delayed word recall tasks varied to some degree across survey waves. For example, in 1998, the CESD depression items, backwards count, and serial 7's were administered between the two recall tasks. In 1996, only cognition items, including date naming, backwards count, object naming, and President/Vice President naming were administered between the two recall tasks. Refer to the questionnaires and codebooks for each wave to determine the order in which questions were asked in each wave. For web administration, respondents are directed to type as many words as they can recall.

Web mode

For web administration, respondents were again directed to type as many words as they can recall, separating each word with a space.

Scoring

Count of number of words that were recalled correctly. Count ranges from 0-10 for all waves except HRS 92 & 94, in which the count ranges from 0-20.

Mental Status

Respondents' mental status was measured by a variety of tests that assess knowledge, language, and orientation. These questions were included in all waves of HRS/AHEAD except HRS 92 and 94. These measures include the Serial 7s test, backwards counting, date naming, object naming, and naming the President and Vice President of the United States. These measures were adapted for use in the HRS from the Telephone Interview of Cognitive Status (Brandt, Spencer and Folstein, 1988), which was modeled after the Mini-Mental State Exam (Folstein, Folstein, and McHugh, 1975) for use over the telephone.

Serial 7's Test

The interviewer asked the respondent to subtract 7 from 100, and continue subtracting 7 from each subsequent number for a total of five trials. It was up to the respondent to remember the value from the prior subtraction, such that the interviewer did not repeat the difference said by the respondent after each trial. Web administration was nearly identical to the interviewer administration, except that the instructions were presented as written text instead of being spoken by the interviewer.

Scoring

Scoring is a count of the number of correct subtractions among the five trials (0-5). Each subtraction was scored independently. For example, if a respondent made a mistake on the first subtraction (e.g., reported 92 instead of 93) but gave correct answers for each subsequent subtraction (using 92 as a starting point and answering 85 for the second subtraction), he/she would receive a score of 4.

Backwards Count starting from 20 and 86

Respondents were asked to count backwards for 10 continuous numbers beginning with the number 20. The instructions to count backwards *as quickly as possible* were added in AHEAD 95 and HRS 96; prior waves did not instruct respondents to count as quickly as possible.

In AHEAD 95, and HRS 1996 - 2002, respondents were also asked to repeat the same task of counting backwards beginning with the number 86. The same instructions for counting as quickly as possible were given. The backwards count from 86 was discontinued in HRS 2004 when major efforts were undertaken to reduce the amount of time taken for the survey, but appeared again in HRS 2010 and 2012.

Web mode

In HRS 2018 and beyond, web administration respondents were not asked either backwards count item. A backwards count from 20 score (RwBWC20W) was imputed for all web cases.

Scoring

2 points if answered correctly on first try; 1 point if correctly answered on second try; 0 if incorrect on first or second try.

Date Naming

Respondents were asked to report "today's date," including the month, day, year, and day of week. In HRS/AHEAD 98 and later waves, this question was only asked of FTF/TEL respondents 65 years of age and older, or of respondents who had not been interviewed in a prior wave.

Scoring

Dichotomous variables for each of the four individual items of month, day of month, year, and day of week. Variables were coded 1=correct and 0=incorrect.

Object Naming

"What do you usually use to cut paper?"
"What do you call the kind of prickly plant that grows in the desert?"

In HRS/AHEAD 98 and later waves, these questions were only asked of FTF/TEL respondents 65 years of age and older, or respondents who had not been interviewed in a prior wave.

Scoring

Dichotomous variables for naming each of the objects correctly. Variables were coded 1=correct and 0=incorrect.

President/Vice President Naming

Respondents were asked to name the current President and Vice President of the United States. In HRS/AHEAD 98 and later waves, this question was only asked of FTF/TEL respondents 65 years of age and older, or of respondents who had not been interviewed in a prior wave.

Scoring

Dichotomous variables for naming the last name of each individual correctly. Variables were coded 1=correct and 0=incorrect.

Vocabulary

A vocabulary measure was used to represent established knowledge, also referred to as crystallized intelligence.

This measure was adapted from the WAIS-R. Specifically, respondents were asked to define 5 words from one of two sets: 1) repair, fabric, domestic, remorse, plagiarize, and 2) conceal,

enormous, perimeter, compassion, audacious. Respondents are randomly assigned to one set of words in the first wave and the sets are alternated in each wave thereafter. This vocabulary test was introduced in AHEAD 95 and HRS 96, and has been retained in all subsequent waves.

In HRS/AHEAD 98, this question was only asked of respondents 65 years of age and older, or of respondents who had not been interviewed in a prior wave. In subsequent waves, the vocabulary measure was administered only to respondents who had not been interviewed in a prior wave (new spouses and new cohorts).

Scoring
Responses to each of five vocabulary items were coded as follows: 2=answered perfectly correct; 1=answered partially correct, and 0=answered incorrect. The scores for each of the five items were summed to create a total score ranging from 0 to 10.

Other

Although the HRS includes a handful of additional cognition measures (e.g., WAIS similarities, numeracy, quantitative reasoning, and verbal fluency modules), these measures were either asked of a small sample of respondents and/or not added to the survey until more recent waves. In order to maintain consistency in the imputation process across waves of the study, these measures were not included here.

Missing Data on Cognitive Measures:

Occasionally respondents will not answer a cognitive test question asked of them during the survey. We *cannot* assume that the data are missing completely at random (MCAR) or missing at random (MAR). It may be the case that respondents refuse to answer a question because they do not know the answer or are afraid they will answer incorrectly. In other words, whether or not a respondent answers a question may be related to their level of cognitive functioning or perceived level of cognitive functioning. As a result, we need to assume that the data are not missing at random (NMAR), where the reason for the missing data may depend on the missing observations even after accounting for all of the relevant observed data available. In order to minimize the effect of missing data, particularly in light of the NMAR missing data assumption, we imputed missing data to yield a more complete data set.

This report only pertains to cognitive tasks performed by self-respondents. In other words, proxy measures of cognition were not imputed, and cognition scores were not imputed for interviews completed with a proxy reporter.

Table 2 shows the number of cases that were missing and imputed for each measure in each wave. Table 3 presents the percentage of cases with at least one imputed measure by age in each wave.

Table 2. Number of Imputed Cognitive Values Per Measure Per Wave

	HRS92 W1	AHD93 W2	HRS94 W2	AHD95 W3	HRS96 W3	HRS98 W4	HRS00 W5	HRS02 W6	HRS04 W7
Number of Core Self Interviews	11883	7382	10691	6126	10225	19341	17516	16130	18327
Immediate Recall	261	219	425	85	56	169	204	339	262
Delayed Recall	348	311	588	211	87	340	329	646	420
Serial 7s	-	834	-	383	324	666	657	537	632
Backwards Count – 20	-	160	-	172	81	146	150	128	147
Backwards Count – 86	-		-	262	150	206	186	155	
Scissors	-	26	-	19	13	22	24	10	16
Cactus	-	31	-	18	11	24	25	12	16
President	-	31	-	16	11	23	26	10	17
VP	-	55	-	16	12	24	25	13	20
Month	-	25	-	14	6	22	18	11	20
Day of Month	-	23	-	6	4	14	8	11	21
Year	-	18	-	7	4	16	11	11	21
Day of Week	-	15	-	6	4	15	10	11	20
Vocabulary	-		-	60	27	81	92	134	3
Self-rated memory	70	7	38	6	9	23	24	18	60
Past mem.	66	5	36	7	12	30	35	28	75

Table 2. (cont.) Number of Imputed Cognitive Values Per Measure Per Wave

	HRS06	HRS08	HRS10	HRS12	HRS14	HRS16	HRS18	HRS20	
	W8	W9	W10	W11	W12	W13	W14[1]	W15[1]	
Number of Core Self Interviews	17209	16077	20652	19407	17698	19971	16483	15002	
Immediate Recall	212	158	209	241	163	209	122	153	
Delayed Recall	371	284	545	600	471	571	241	298	
Serial 7s	431	423	348	395	273	324	262	261	
Backwards Count – 20	104	85	86	79	77	80	81	54	
Backwards Count – 86	-	-	104	109	-	-	-	-	
Scissors	27	19	8	12	10	20	10	12	
Cactus	27	21	13	16	13	22	15	17	
President	27	20	15	19	15	32	25	18	
VP	27	18	20	20	23	40	17	18	
Month	28	18	9	15	9	15	12	12	
Day of Month	29	18	10	16	9	16	12	12	
Year	30	17	8	15	9	16	12	14	
Day of Week	28	17	11	15	9	14	12	12	
Vocabulary	108	1	77	6	2	51	1	7	
Self-rated memory	23	14	21	18	17	19	15	26	
Past mem.	33	35	40	33	22	33	17	37	

[1] Excludes imputation of Backward Count – 20 for all WEB mode respondents.

Table 3. Percentage of Respondents by Age with at Least One Imputed Cognition Score

	HRS92	AHD93	HRS94	AHD95	HRS96	HRS98	HRS00	HRS02	HRS04
Age	W1	W2	W2	W3	W3	W4	W5	W6	W7
< 51	2.3%		4.4%		3.0%	3.1%	2.8%	5.4%	2.9%
51-59	3.0%	13.6%	5.3%	11.1%	4.0%	3.2%	3.0%	5.4%	3.6%
60-69	3.9%	10.4%	6.5%	6.6%	5.3%	4.4%	4.6%	6.8%	4.8%
70-79	3.5%	11.4%	7.9%	8.4%	7.4%	5.4%	5.9%	8.8%	5.2%
80-89		19.6%		14.0%		9.6%	10.9%	11.2%	7.9%
90+		34.3%		24.4%		20.2%	20.7%	21.6%	14.8%
Total	3.1%	14.1%	5.6%	10.6%	4.6%	4.9%	5.4%	7.8%	5.0%

	HRS06	HRS08	HRS10	HRS12	HRS14	HRS16	HRS18	HRS20	
Age	W8	W9	W10	W11	W12	W13	W14[2]	W15[2]	
< 51	1.7%	2.4%	2.8%	2.1%	3.1%	3.1%	1.9%	1.8%	
51-59	3.2%	2.4%	3.0%	2.8%	2.5%	3.7%	1.5%	3.3%	
60-69	3.7%	3.0%	4.1%	4.0%	3.3%	3.9%	3.2%	3.0%	
70-79	5.1%	4.5%	6.0%	6.6%	5.2%	5.6%	4.1%	4.5%	
80-89	7.6%	7.1%	8.3%	9.8%	7.9%	8.7%	4.9%	6.1%	
90+	13.1%	11.8%	16.3%	15.9%	10.7%	11.0%	6.8%	10.1%	
Total	4.6%	4.1%	4.8%	5.2%	4.3%	4.8%	3.2%	3.9%	

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[2] Excludes imputation of Backward Count – 20 for all WEB mode respondents.

Imputation Process

Overview

The objective was to perform imputations for respondents with missing cognition data using a multivariate, regression-based procedure using Imputation and Variance Estimation (IVEware) software (http://www.isr.umich.edu/src/smp/ive/). We used a combination of relevant demographic, health, and economic variables, as well as prior and current wave cognitive variables to perform the imputations. Prior wave cognitive scores were used to perform the imputations, except for the baseline waves for each of the cohorts where subsequent wave scores were used instead. More detail regarding our imputation strategy follows.

Cognition imputations were calculated for self-respondents who completed an HRS interview in a given wave, regardless of their proxy status in a prior (or later) wave. We did not perform imputations for proxy respondents or non-participants in a given wave. Table 2 shows the number of values imputed for each of the cognitive measures at each wave. Values were imputed to replace missing values, refusals (RF), and any not applicable (NA) response. Don't Know (DK) responses were coded as incorrect and were not imputed. Although a few cognition modules have also been administered in HRS at various waves (e.g., WAIS similarities in HRS 1992 and AHEAD 1993; WJ-III Number Series in 2004), these were not included in the imputations because only a small subset of respondents were asked to complete each module. New measures of cognition added to HRS (including numeracy, quantitative reasoning and verbal reasoning) were not included in the imputation process because they were added in much later waves and not available across time for all self-respondents.

Imputation Steps

Imputation of cognitive measures included non-changing baseline demographics, wave-specific demographics, and other wave-specific predictor variables in addition to the cognitive measures. First we assembled the baseline demographic variables, and imputed missing values with IVEware where necessary. Next we assembled the wave-specific variables and imputed missing values where necessary. Finally, we assembled the cognitive measures and imputed missing values with non-changing baseline demographics, wave-specific demographics, and other wave-specific predictor variables included in the IVEware models. Starting in 2018, this final imputation of the cognitive measures was carried out by mode, with separate models for interviewer-administered (FTF/TEL) and self-administered (WEB) cases.

1. *Non-changing Baseline Demographics:*
    The following items are asked in a respondent's baseline interview of HRS and were included as baseline demographic predictors to compute the imputations. In a small number of cases, demographic variables were missing. Imputations were performed to fill in missing values on the baseline demographic variables before proceeding with the cognition imputations in order to ensure that the cognition imputations were performed using complete baseline demographic data.

    <u>*Variable*</u>
    Year of birth (BIRTHYR)
    Month of birth (BIRTHMO)
    Years of education (SCHLYRS)
    Respondent's highest degree earned (MAX__DEG)
    Gender
    Race
    Hispanic ethnicity
    Father's years of education
    Mother's years of education
    College degree (from DEGREE)

    The source of most of these variables was the HRS Tracker file. Additional variables were compiled from respondents' baseline interview using the variable FIRSTIW in the Tracker file[3].

2. *Wave-specific predictors:*
    In addition to the baseline demographics, the following wave-specific predictors were included when computing the cognition imputations. In a small number of cases, wave-specific predictor variables were missing. Imputations were performed to fill in missing values on the baseline demographic variables before proceeding with the cognition imputations in order to ensure that the cognition imputations were performed using complete baseline demographic data.

    a. Demographics
         age,
         age^2
         age^3
         self vs. proxy status
         interview language

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[3] The HRS Tracker file is updated periodically. The most recent version of the Tracker file (as of the imputation file release date) was used for the current imputations and any imputations computed for prior waves was left as-is, not updated again based on a newer version of the Tracker file.

coupleness
nursing home status

b. Economic Status[4]
    Household income
    Net worth

IVEware imputations of Income and net worth often produced values that were wildly inconsistent with values reported at the preceding wave. To address this, we took the previous wave's report and adjusted it by a factor equal to the mean of reported values for the current wave divided by the mean of reported value for the previous wave. For a few cases in which prior wave reports of income were not available, we imputed based on the closest wave (either before or after the current wave) for which you have reported or previously imputed data for the household, and adjusted that reported value by multiplying it by the factor, [mean of reported and imputed values for current wave/ mean of reported and imputed values for the wave with a reported or imputed value for the case]. Any households that never reported income or net worth, and for which values for these variables have never been imputed, we imputed the median of the reported and imputed values for each wave.

c. Health Status
    Self-Rated Health
    Rate Past Health
    Whether has hypertension
    Whether has heart disease
    Whether has had a stroke
    Diabetes severity (3 categories: No diabetes; Has diabetes but not receiving any meds/insulin; Has diabetes and taking meds and/or insulin)
    Rate vision
    Rate distal vision (not available in 1992 and 1994) ,
    Rate Near Vision (not available in 1992 and 1994),
    Rate Hearing

d. Physical Functioning
    Nagi items
    ADLs (number of activities with which R has difficulty)
    IADLs (number of activities with which R has difficulty)

3. *Cognition variables*

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[4] Based on data availability and a comparison of results from 2018 models including and excluding household income and net worth, the economic status variables were not included in the 2020 core cognition imputation model.

Prior and current wave cognitive scores were used to impute missing cognitive scores, except for the baseline wave for each cohort added through 1998, where subsequent wave scores were used instead. (See Table 4.)

Methodological Issues

Self-respondents. Cognition imputations were calculated for self-respondents who completed an HRS interview in a given wave. We did not perform imputations for proxy respondents or non-participants in a given wave. We exclude respondents that never did any self, core interview. Table 2 shows the number of values imputed for each of the cognitive measures at each wave.

Which values were imputed. Values were imputed to replace missing values, refusals (RF), and any not applicable (NA) response. Don't Know (DK) responses were coded as incorrect and were not imputed. Although a few cognition modules have also been administered in HRS at various waves (e.g., WAIS similarities in HRS 1992 and AHEAD 1993; WJ-III Number Series in 2004), these were not included in the imputations because only a small subset of respondents were asked to complete each module.

Imputations performed by cohort prior to 2000. Due to wave-specific differences in the set of cognition measures asked as well as some slight differences in other relevant predictor variables, we performed imputations separately by cohort for all waves prior to 2000, and with all respondents together for each of the later (2000 - 2020) waves. Table 3 shows how imputations were performed for each cohort at each wave. Data in waves 2, 3, and 4 were merged together *after* performing the imputations by cohort.

Immediate and Delayed Word Recall. In the raw data, delayed recall scores rarely exceeded immediate recall scores. However, the proportion of imputed delayed recall scores that were higher than immediate recall scores was higher than in the raw data, particularly when the immediate recall score was imputed as 0. As a result, we recoded imputed delayed recall scores as 0 when the immediate recall score was 0. We considered constraining the imputations of delayed recall to values less than or equal to the immediate recall score, but that seemed overly restrictive because some pairs of non-imputed scores do in fact show higher delayed recall than immediate recall (though usually by just one word).

The word list used for the immediate and delayed word recall task consisted of 20 words in HRS 1992 (W1) and HRS 1994 (W2), and was later changed to 10 words. The AHEAD survey used a 10-word list. Although HRS 1994 and AHEAD 1993 are both named as W2, results are presented separately because the word list tasks differed between the waves, and only AHEAD had additional cognitive measures that wave. Cognitive imputation data from HRS 1994 and AHEAD 1993 have been merged together for Wave 2 (W2). The flag variable, R2FLAG, indicates whether the data are from HRS 1994 or AHEAD 1993.

Web cases (2018 – forward). Web cases do not distinguish between "don't know", "refuse", and other forms of nonresponse. For the immediate and delayed word recall tasks in web mode, there is not a method for the respondent to directly indicate "none remembered", however there are several cases in which the respondent provided no response to these tasks. For the web interviews, missing data on the cognitive test items is treated simply as data to be imputed, and not as indicative of an incorrect response.

Table 4. Overview of Cognitive Imputations Procedure by Cohort.

Wave	AHEAD	HRS	CODA / WB	EBB	MBB	LBB	
W1		1992					*impute 1992 using raw 1992 & 1994 data
W2	1993						*impute 1993 using raw 1993 &1995 data
		1994					*impute 1994 using 1992 imputed data + raw 1994 data
W3	1995						*impute 1995 using 1993 imputed data + raw 1995 data
		1996					*impute 1996 using 1994 imputed data + raw 1996 data
W4	1998						*impute 1998 using 1995 imputed data + raw 1998 data
		1998					*impute 1998 using 1996 imputed data + raw 1998 data
			1998				*impute 1998 using raw 1998 & raw 2000 data
W5		2000					*impute 2000 using 1998 merged imputed data + raw 2000 data
W6		2002					*impute 2002 using 2000 imputed data + raw 2002 data
W7		2004					*impute 2004 using 2002 imputed data + raw 2004 data
W8		2006					*impute 2006 using 2004 imputed data + raw 2006 data
W9		2008					*impute 2008 using 2006 imputed data + raw 2008 data
W10		2010					*impute 2010 using 2008 imputed + raw 2010 data
W11		2012					*impute 2012 using 2010 imputed data + raw 2012 data
W12		2014					*impute 2014 using 2012 imputed data + raw 2014 data
W13		2016					*impute 2016 using 2014 imputed data + raw 2016 data
W14		2018					*impute 2018 using 2016 imputed data + raw 2018 data
W15		2020					*impute 2020 using 2018 imputed data + raw 2020 data

Results

For additional information about scoring, please refer to the earlier section: Measures.

Tables 5-20 present descriptive statistics for unimputed as well as imputed cases. Because the imputed data are based on observations not missing at random (NMAR), we would expect the imputed values to be lower than the unimputed values. The results in these tables support this.

Tables 21-22 show the correlation between the level of cognition and extent of imputation. Specifically, Table 22 presents the correlation between cognitive scores and whether *any* data in that wave were imputed. Table 23 shows correlations between cognitive scores and the number of cognition values that were imputed for each respondent. These results show that in general, the higher the cognitive score, the less likely it is that any cognitive data were imputed.

Table 5. Wave 1 - HRS 1992 Descriptive Statistics

Wave 1 HRS 1992	Non-Imputed cases			Imputed Cases			Total			Range
	N	Mean	Std Dev	N	Mean	Std Dev	N	Mean	Std Dev	
Immediate Word Recall	11622	7.447	2.679	261	7.111	4.495	11883	7.440	2.732	0-20
Delayed Word Recall	11535	5.419	2.857	348	4.868	4.351	11883	5.403	2.913	0-20
Serial 7s										0-5
Backwards Count from 20										0,1,2
Backwards Count from 86										0,1,2
Scissors										0,1
Cactus										0,1
President										0,1
Vice President										0,1
Date: Month										0,1
Date: Day										0,1
Date: Year										0,1
Date: day of week										0,1
Vocabulary Sum Score										0,1
Self-rated memory	11813	2.436	1.027	70	2.486	0.880	11883	2.436	1.026	1-5
Memory compared to past	11817	2.037	0.464	66	2.045	0.409	11883	2.037	0.463	1-3

Table 6. Wave 2 – AHEAD 1993 Descriptive Statistics

Wave 2 AHEAD 1993	Non-Imputed cases			Imputed Cases			Total			
	N	Mean	Std Dev	N	Mean	Std Dev	N	Mean	Std Dev	Range
Immediate Word Recall	7163	4.581	1.910	219	3.429	2.472	7382	4.547	1.938	0-10
Delayed Word Recall	7071	3.199	2.227	311	2.325	2.383	7382	3.162	2.240	0-10
Serial 7s	6548	3.371	1.656	834	1.787	1.488	7382	3.192	1.713	0-5
Backwards Count from 20	7222	1.822	0.538	160	1.206	0.745	7382	1.808	0.550	0,1,2
Backwards Count from 86										0,1,2
Scissors	7356	0.989	0.105	26	0.885	0.326	7382	0.988	0.107	0,1
Cactus	7351	0.833	0.373	31	0.645	0.486	7382	0.832	0.374	0,1
President	7351	0.906	0.292	31	0.613	0.495	7382	0.904	0.294	0,1
Vice President	7327	0.718	0.450	55	0.491	0.505	7382	0.716	0.451	0,1
Date: Month	7357	0.955	0.208	25	0.880	0.332	7382	0.954	0.209	0,1
Date: Day	7359	0.792	0.406	23	0.652	0.487	7382	0.792	0.406	0,1
Date: Year	7364	0.951	0.216	18	0.833	0.383	7382	0.951	0.216	0,1
Date: Day of Week	7367	0.960	0.195	15	0.933	0.258	7382	0.960	0.196	0,1
Vocab Sum Score										0-10
Self-rated Memory	7375	2.846	0.997	7	2.143	1.069	7382	2.845	0.998	1-5
Memory Compared to Past	7377	2.097	0.384	5	2.200	0.447	7382	2.097	0.384	1-3

Table 7. Wave 2 – HRS 1994 Descriptive Statistics

Wave 2 HRS 1994	Non-Imputed cases			Imputed Cases			Total			
	N	Mean	Std Dev	N	Mean	Std Dev	N	Mean	Std Dev	Range
Immediate Word Recall	10266	7.909	3.105	425	7.944	4.549	10691	7.910	3.175	0-20
Delayed Word Recall	10103	6.058	3.266	588	5.532	4.580	10691	6.030	3.354	0-20
Serial 7s										0-5
Backwards Count from 20										0,1,2
Backwards Count from 86										0,1,2
Scissors										0,1
Cactus										0,1
President										0,1
Vice President										0,1
Date: Month										0,1
Date: Day										0,1
Date: Year										0,1
Date: day of week										0,1
Vocab Sum Score										0-10
Self-rated memory	10653	2.562	1.037	38	2.316	0.962	10691	2.562	1.037	1-5
Memory compared to past	10655	2.057	0.432	36	2.111	0.523	10691	2.057	0.432	1-3

Table 8. Wave 3 - AHEAD 1995 and HRS 1996 Descriptive Statistics

Wave 3 AHEAD 1995 and HRS 1996	Non-Imputed cases			Imputed Cases			Total			Range
	N	Mean	Std Dev	N	Mean	Std Dev	N	Mean	Std Dev	
Immediate Word Recall	16210	5.548	1.863	141	4.184	2.618	16351	5.536	1.875	0-10
Delayed Word Recall	16053	4.451	2.232	298	1.701	2.543	16351	4.401	2.268	0-10
Serial 7s	15644	3.500	1.670	707	1.969	1.588	16351	3.434	1.695	0-5
Backwards Count from 20	16098	1.919	0.392	253	1.198	0.817	16351	1.908	0.412	0,1,2
Backwards Count from 86	15939	1.747	0.664	412	0.942	0.814	16351	1.727	0.680	0,1,2
Scissors	16319	0.988	0.107	32	0.938	0.246	16351	0.988	0.108	0,1
Cactus	16322	0.894	0.307	29	0.621	0.494	16351	0.894	0.308	0,1
President	16324	0.938	0.241	27	0.852	0.362	16351	0.938	0.242	0,1
Vice President	16323	0.712	0.453	28	0.393	0.497	16351	0.711	0.453	0,1
Date: Month	16331	0.974	0.158	20	0.900	0.308	16351	0.974	0.158	0,1
Date: Day	16341	0.835	0.371	10	0.600	0.516	16351	0.835	0.371	0,1
Date: Year	16340	0.975	0.155	11	0.909	0.302	16351	0.975	0.155	0,1
Date: day of week	16341	0.976	0.152	10	0.900	0.316	16351	0.976	0.152	0,1
Vocabulary Sum Score	16264	5.298	2.152	87	4.299	2.543	16351	5.293	2.156	0-10
Self-rated memory	16336	2.970	0.974	15	2.867	0.834	16351	2.970	0.974	1-5
Memory compared to past	16332	2.158	0.439	19	2.053	0.524	16351	2.158	0.439	1-3

Table 9. Wave 4 – HRS 1998 Descriptive Statistics

Wave 4 HRS 1998	Non-Imputed cases			Imputed Cases			Total			Range
	N	Mean	Std Dev	N	Mean	Std Dev	N	Mean	Std Dev	
Immediate Word Recall	19172	5.663	1.848	169	4.982	2.565	19341	5.657	1.857	0-10
Delayed Word Recall	19001	4.593	2.216	340	2.026	2.710	19341	4.548	2.251	0-10
Serial 7s	18675	3.528	1.680	666	1.842	1.511	19341	3.470	1.703	0-5
Backwards Count from 20	19195	1.910	0.414	146	1.349	0.775	19341	1.905	0.421	0,1,2
Backwards Count from 86	19135	1.728	0.684	206	0.961	0.849	19341	1.720	0.691	0,1,2
Scissors	12308	0.991	0.097	22	0.909	0.294	12330	0.990	0.097	0,1
Cactus	12306	0.904	0.294	24	0.875	0.338	12330	0.904	0.295	0,1
President	12307	0.958	0.201	23	0.913	0.288	12330	0.958	0.201	0,1
Vice President	12306	0.840	0.366	24	0.625	0.495	12330	0.840	0.367	0,1
Date: Month	12308	0.973	0.163	22	0.909	0.294	12330	0.973	0.164	0,1
Date: Day	12316	0.826	0.379	14	0.714	0.469	12330	0.826	0.379	0,1
Date: Year	12314	0.965	0.183	16	0.938	0.250	12330	0.965	0.183	0,1
Date: day of week	12315	0.970	0.172	15	0.867	0.352	12330	0.970	0.172	0,1
Vocabulary Sum Score	12249	5.580	2.113	81	3.975	2.725	12330	5.570	2.122	0-10
Self-rated memory	19318	2.880	0.955	23	3.043	0.928	19341	2.880	0.955	1-5
Memory compared to past	19311	2.161	0.437	30	2.300	0.466	19341	2.161	0.437	1-3

Table 10. Wave 5 – HRS 2000 Descriptive Statistics

Wave 5 HRS 2000	Non-Imputed cases			Imputed Cases			Total			Range
	N	Mean	Std Dev	N	Mean	Std Dev	N	Mean	Std Dev	
Immediate Word Recall	17313	5.481	1.802	204	4.373	2.495	17517	5.468	1.816	0-10
Delayed Word Recall	17188	4.458	2.140	329	2.143	2.622	17517	4.415	2.173	0-10
Serial 7s	16859	3.536	1.683	658	1.758	1.463	17517	3.469	1.709	0-5
Backwards Count from 20	17367	1.909	0.415	150	1.167	0.806	17517	1.902	0.425	0,1,2
Backwards Count from 86	17331	1.726	0.686	186	0.968	0.811	17517	1.718	0.692	0,1,2
Scissors	9480	0.992	0.090	24	0.958	0.204	9504	0.992	0.091	0,1
Cactus	9479	0.901	0.299	25	0.760	0.436	9504	0.901	0.299	0,1
President	9478	0.949	0.221	26	0.731	0.452	9504	0.948	0.222	0,1
Vice President	9479	0.901	0.299	25	0.560	0.507	9504	0.900	0.300	0,1
Date: Month	9486	0.970	0.170	18	0.889	0.323	9504	0.970	0.171	0,1
Date: Day	9496	0.821	0.383	8	0.750	0.463	9504	0.821	0.383	0,1
Date: Year	9493	0.976	0.152	11	0.818	0.405	9504	0.976	0.152	0,1
Date: day of week	9494	0.968	0.177	10	0.900	0.316	9504	0.968	0.177	0,1
Vocabulary Sum Score	9469	5.484	2.096	92	3.870	2.504	9504	5.469	2.106	0-10
Self-rated memory	17493	2.933	0.928	24	3.083	0.504	17517	2.933	0.927	1-5
Memory compared to past	17482	2.153	0.421	35	2.086	0.445	17517	2.153	0.421	1-3

Table 11. Wave 6 – HRS 2002 Descriptive Statistics

Wave 6 HRS 2002	Non-Imputed cases			Imputed Cases			Total			Range
	N	Mean	Std Dev	N	Mean	Std Dev	N	Mean	Std Dev	
Immediate Word Recall	15791	5.485	1.740	339	4.965	2.609	16130	5.474	1.764	0-10
Delayed Word Recall	15484	4.550	2.068	646	3.399	2.667	16130	4.504	2.108	0-10
Serial 7s	15593	3.550	1.706	537	1.764	1.447	16130	3.491	1.728	0-5
Backwards Count from 20	16002	1.913	0.406	128	1.273	0.791	16130	1.908	0.415	0,1,2
Backwards Count from 86	15975	1.743	0.668	155	0.955	0.767	16130	1.736	0.674	0,1,2
Scissors	9601	0.989	0.104	10	0.900	0.316	9611	0.989	0.104	0,1
Cactus	9599	0.904	0.294	12	0.667	0.492	9611	0.904	0.295	0,1
President	9601	0.957	0.202	10	0.700	0.483	9611	0.957	0.203	0,1
Vice President	9598	0.687	0.464	13	0.385	0.506	9611	0.687	0.464	0,1
Date: Month	9600	0.964	0.186	11	0.818	0.405	9611	0.964	0.187	0,1
Date: Day	9600	0.835	0.372	11	0.727	0.467	9611	0.834	0.372	0,1
Date: Year	9600	0.956	0.205	11	0.727	0.467	9611	0.956	0.206	0,1
Date: day of week	9600	0.955	0.207	11	0.818	0.405	9611	0.955	0.207	0,1
Vocabulary Sum Score	9477	5.524	2.049	134	4.604	2.687	9611	5.511	2.062	0-10
Self-rated memory	16112	2.959	0.918	18	3.278	0.895	16130	2.959	0.918	1-5
Memory compared to past	16102	2.183	0.433	28	2.393	0.497	16130	2.184	0.434	1-3

Table 12. Wave 7 – HRS 2004 Descriptive Statistics

Wave 7 HRS 2004	Non-Imputed cases			Imputed Cases			Total			Range
	N	Mean	Std Dev	N	Mean	Std Dev	N	Mean	Std Dev	
Immediate Word Recall	18065	5.437	1.654	262	4.737	2.742	18327	5.427	1.677	0-10
Delayed Word Recall	17907	4.386	1.993	420	2.836	2.882	18327	4.351	2.031	0-10
Serial 7s	17695	3.584	1.649	632	1.979	1.592	18327	3.529	1.673	0-5
Backwards Count from 20	18180	1.900	0.433	147	1.238	0.762	18327	1.895	0.441	0,1,2
Backwards Count from 86										0,1,2
Scissors	13067	0.990	0.101	16	0.875	0.342	13083	0.990	0.101	0,1
Cactus	13067	0.914	0.280	16	0.750	0.447	13083	0.914	0.280	0,1
President	13066	0.972	0.165	17	0.706	0.470	13083	0.972	0.166	0,1
Vice President	13063	0.763	0.426	20	0.350	0.489	13083	0.762	0.426	0,1
Date: Month	13063	0.966	0.181	20	0.750	0.444	13083	0.966	0.182	0,1
Date: Day	13062	0.826	0.379	21	0.476	0.512	13083	0.825	0.380	0,1
Date: Year	13062	0.968	0.177	21	0.762	0.436	13083	0.967	0.178	0,1
Date: day of week	13063	0.959	0.198	20	0.700	0.470	13083	0.959	0.199	0,1
Vocabulary Sum Score	3258	5.673	2.077	3	3.667	1.155	3261	5.671	2.077	0-10
Self-rated memory	18267	2.985	0.968	60	3.233	0.767	18327	2.986	0.968	1-5
Memory compared to past	18252	2.203	0.471	75	2.320	0.524	18327	2.204	0.471	1-3

Table 13. Wave 8 – HRS 2006 Descriptive Statistics

Wave 8 HRS 2006	Non-Imputed cases			Imputed Cases			Total			Range
	N	Mean	Std Dev	N	Mean	Std Dev	N	Mean	Std Dev	
Immediate Word Recall	16997	5.399	1.722	212	4.642	2.716	17209	5.390	1.740	0-10
Delayed Word Recall	16838	4.370	2.047	371	2.445	2.664	17209	4.328	2.081	0-10
Serial 7s	16778	3.550	1.695	431	2.067	1.587	17209	3.513	1.708	0-5
Backwards Count from 20	17105	1.885	0.464	104	1.279	0.794	17209	1.881	0.469	0,1,2
Backwards Count from 86										0,1,2
Scissors	10490	0.987	0.112	27	0.926	0.267	10517	0.987	0.113	0,1
Cactus	10490	0.903	0.296	27	0.704	0.465	10517	0.903	0.296	0,1
President	10490	0.966	0.181	27	0.815	0.396	10517	0.966	0.182	0,1
Vice President	10490	0.769	0.421	27	0.444	0.506	10517	0.768	0.422	0,1
Date: Month	10489	0.956	0.205	28	0.714	0.460	10517	0.956	0.206	0,1
Date: Day	10488	0.802	0.398	29	0.517	0.509	10517	0.801	0.399	0,1
Date: Year	10487	0.958	0.202	30	0.600	0.498	10517	0.957	0.204	0,1
Date: day of week	10489	0.955	0.208	28	0.679	0.476	10517	0.954	0.209	0,1
Vocabulary Sum Score	10409	5.461	2.063	108	4.667	2.372	10517	5.453	2.068	0-10
Self-rated memory	17186	3.000	0.956	23	3.043	0.825	17209	3.000	0.956	1-5
Memory compared to past	17176	2.202	0.456	33	2.273	0.452	17209	2.202	0.456	1-3

Table 14. Wave 9 – HRS 2008 Descriptive Statistics

Wave 9 HRS 2008	Non-Imputed cases			Imputed Cases			Total			Range
	N	Mean	Std Dev	N	Mean	Std Dev	N	Mean	Std Dev	
Immediate Word Recall	15919	5.366	1.704	158	4.696	2.694	16077	5.359	1.717	0-10
Delayed Word Recall	15793	4.357	2.023	284	2.300	2.666	16077	4.321	2.054	0-10
Serial 7s	15654	3.518	1.686	423	2.099	1.622	16077	3.480	1.700	0-5
Backwards Count from 20	15992	1.888	0.457	85	1.188	0.732	16077	1.884	0.462	0,1,2
Backwards Count from 86										0,1,2
Scissors	10499	0.987	0.114	19	0.947	0.229	10518	0.987	0.115	0,1
Cactus	10497	0.905	0.293	21	0.762	0.436	10518	0.905	0.294	0,1
President	10498	0.964	0.186	20	0.650	0.489	10518	0.964	0.187	0,1
Vice President	10500	0.746	0.435	18	0.611	0.502	10518	0.746	0.435	0,1
Date: Month	10500	0.958	0.201	18	0.833	0.383	10518	0.958	0.202	0,1
Date: Day	10500	0.808	0.394	18	0.500	0.514	10518	0.807	0.394	0,1
Date: Year	10501	0.958	0.202	17	0.824	0.393	10518	0.957	0.202	0,1
Date: day of week	10501	0.956	0.206	17	0.824	0.393	10518	0.956	0.206	0,1
Vocabulary Sum Score	123	5.618	2.118	1	6.000	-	124	5.621	2.109	0-10
Self-rated memory	16063	3.008	0.942	14	3.143	1.292	16077	3.008	0.942	1-5
Memory compared to past	16042	2.198	0.460	35	2.314	0.530	16077	2.198	0.460	1-3

Table 15. Wave 10 – HRS 2010 Descriptive Statistics

Wave 10 HRS 2010	Non-Imputed cases			Imputed Cases			Total			Range
	N	Mean	Std Dev	N	Mean	Std Dev	N	Mean	Std Dev	
Immediate Word Recall	20443	5.380	1.642	209	4.282	2.090	20652	5.369	1.651	0-10
Delayed Word Recall	20107	4.336	1.940	545	2.554	2.305	20652	4.289	1.971	0-10
Serial 7s	20304	3.427	1.677	348	2.006	1.533	20652	3.403	1.684	0-5
Backwards Count from 20	20566	1.856	0.515	86	1.221	0.788	20652	1.853	0.518	0,1,2
Backwards Count from 86	20548	1.607	0.793	104	0.952	0.768	20652	1.604	0.795	0,1,2
Scissors	16023	0.985	0.123	8	0.625	0.518	16031	0.985	0.123	0,1
Cactus	16018	0.915	0.279	13	0.692	0.480	16031	0.915	0.280	0,1
President	16016	0.966	0.181	15	0.733	0.458	16031	0.966	0.182	0,1
Vice President	16011	0.535	0.499	20	0.350	0.489	16031	0.535	0.499	0,1
Date: Month	16022	0.965	0.183	9	0.889	0.333	16031	0.965	0.183	0,1
Date: Day	16021	0.813	0.390	10	0.800	0.422	16031	0.813	0.390	0,1
Date: Year	16023	0.967	0.178	8	0.750	0.463	16031	0.967	0.179	0,1
Date: day of week	16020	0.963	0.188	11	0.727	0.467	16031	0.963	0.188	0,1
Vocabulary Sum Score	15954	5.440	2.103	77	4.740	2.314	16031	5.436	2.104	0-10
Self-rated memory	20631	2.937	0.963	21	2.857	1.108	20652	2.937	0.963	1-5
Memory compared to past	20612	2.193	0.478	40	2.350	0.533	20652	2.194	0.478	1-3

Table 16. Wave 11 – HRS 2012 Descriptive Statistics

Wave 11 HRS 2012	Non-Imputed cases			Imputed Cases			Total			Range
	N	Mean	Std Dev	N	Mean	Std Dev	N	Mean	Std Dev	
Immediate Word Recall	19166	5.331	1.670	241	4.382	2.098	19407	5.319	1.680	0-10
Delayed Word Recall	18807	4.330	1.966	600	2.543	2.263	19407	4.275	2.000	0-10
Serial 7s	19012	3.394	1.695	395	1.911	1.526	19407	3.364	1.705	0-5
Backwards Count from 20	19328	1.845	0.532	79	1.380	0.756	19407	1.843	0.534	0,1,2
Backwards Count from 86	19298	1.602	0.797	109	0.826	0.859	19407	1.597	0.800	0,1,2
Scissors	10238	0.985	0.123	12	0.750	0.452	10250	0.984	0.124	0,1
Cactus	10234	0.918	0.274	16	0.625	0.500	10250	0.917	0.275	0,1
President	10231	0.962	0.191	19	0.842	0.375	10250	0.962	0.191	0,1
Vice President	10230	0.629	0.483	20	0.400	0.503	10250	0.629	0.483	0,1
Date: Month	10235	0.951	0.216	15	0.867	0.352	10250	0.951	0.217	0,1
Date: Day	10234	0.777	0.416	16	0.563	0.512	10250	0.777	0.417	0,1
Date: Year	10235	0.948	0.222	15	0.733	0.458	10250	0.948	0.223	0,1
Date: day of week	10235	0.951	0.216	15	0.733	0.458	10250	0.951	0.217	0,1
Vocabulary Sum Score	457	5.306	2.063	6	6.667	3.077	463	5.324	2.080	0-10
Self-rated memory	19389	2.995	0.952	18	3.333	0.767	19407	2.995	0.952	1-5
Memory compared to past	19374	2.166	0.454	33	2.152	0.442	19407	2.166	0.454	1-3

Table 17. Wave 12 – HRS 2014 Descriptive Statistics

Wave 12 HRS 2014	Non-Imputed cases			Imputed Cases			Total			Range
	N	Mean	Std Dev	N	Mean	Std Dev	N	Mean	Std Dev	
Immediate Word Recall	17535	5.343	1.719	163	4.626	2.502	17698	5.336	1.729	0-10
Delayed Word Recall	17227	4.356	1.991	471	2.594	2.477	17698	4.309	2.025	0-10
Serial 7s	17425	3.446	1.681	273	1.971	1.569	17698	3.424	1.689	0-5
Backwards Count from 20	17621	1.853	0.520	77	1.455	0.699	17698	1.851	0.522	0,1,2
Backwards Count from 86										0,1,2
Scissors	9682	0.983	0.128	10	1.000	0.000	9692	0.983	0.124	0,1
Cactus	9679	0.914	0.280	13	0.846	0.376	9692	0.914	0.275	0,1
President	9677	0.962	0.192	15	1.000	0.000	9692	0.962	0.191	0,1
Vice President	9669	0.624	0.484	23	0.522	0.511	9692	0.624	0.483	0,1
Date: Month	9683	0.949	0.220	9	0.889	0.333	9692	0.949	0.217	0,1
Date: Day	9683	0.783	0.413	9	0.667	0.500	9692	0.782	0.417	0,1
Date: Year	9863	0.945	0.228	9	0.778	0.441	9692	0.945	0.223	0,1
Date: day of week	9863	0.948	0.221	9	0.778	0.441	9692	0.948	0.217	0,1
Vocabulary Sum Score	166	4.855	2.189	2	5.000	1.414	168	4.857	2.179	0-10
Self-rated memory	17681	3.060	0.925	17	3.647	0.996	17698	3.061	0.925	1-5
Memory compared to past	17676	2.172	0.457	22	2.182	0.395	17698	2.172	0.457	1-3

Table 18. Wave 13 – HRS 2016 Descriptive Statistics

Wave 13 HRS 2016	Non-Imputed cases			Imputed Cases			Total			Range
	N	Mean	Std Dev	N	Mean	Std Dev	N	Mean	Std Dev	
Immediate Word Recall	19762	5.365	1.663	209	4.617	2.681	19971	5.358	1.679	0-10
Delayed Word Recall	19400	4.359	1.948	571	2.820	2.446	19971	4.315	1.980	0-10
Serial 7s	19647	3.460	1.673	324	2.123	1.614	19971	3.439	1.681	0-5
Backwards Count from 20	19891	1.864	0.502	80	1.063	0.862	19971	1.861	0.507	0,1,2
Backwards Count from 86										0,1,2
Scissors	13680	0.985	0.121	20	0.950	0.224	13700	0.985	0.121	0,1
Cactus	13678	0.921	0.270	22	0.682	0.477	13700	0.920	0.271	0,1
President	13668	0.972	0.164	32	0.750	0.440	13700	0.972	0.165	0,1
Vice President	13660	0.631	0.483	40	0.350	0.483	13700	0.630	0.483	0,1
Date: Month	13685	0.959	0.198	15	0.400	0.507	13700	0.959	0.199	0,1
Date: Day	13684	0.808	0.394	16	0.500	0.516	13700	0.808	0.394	0,1
Date: Year	13684	0.958	0.200	16	0.563	0.512	13700	0.958	0.201	0,1
Date: day of week	13686	0.958	0.201	14	0.643	0.497	13700	0.958	0.202	0,1
Vocabulary Sum Score	4453	5.426	2.173	51	4.745	2.855	4504	5.418	2.183	0-10
Self-rated memory	19952	2.970	0.966	19	3.368	1.422	19971	2.970	0.966	1-5
Memory compared to past	19938	2.177	0.474	33	2.182	0.584	19971	2.177	0.474	1-3

Table 19. Wave 14 – HRS 2018 Descriptive Statistics

Wave 14 HRS 2018	Non-Imputed cases			Imputed Cases			Total			Range
	N	Mean	Std Dev	N	Mean	Std Dev	N	Mean	Std Dev	
Immediate Word Recall (TEL/FTF)	14986	5.544	1.697	100	5.050	2.540	15086	5.541	1.704	0-10
Delayed Word Recall (TEL/FTF)	14911	4.498	2.031	175	2.331	2.874	15086	4.473	2.056	0-10
Immediate Word Recall (WEB)	1375	6.219	1.814	22	6.227	2.599	1397	6.219	1.827	0-10
Delayed Word Recall (WEB)	1331	5.367	2.020	66	4.576	2.450	1397	5.329	2.049	0-10
Serial 7s	16221	3.501	1.672	262	2.004	1.587	16483	3.477	1.681	0-5
Backwards Count from 20*	15005	1.856	0.516	81	1.111	0.806	15086	1.852	0.520	0,1,2
Backwards Count from 86										0,1,2
Scissors	7808	0.986	0.116	10	1.000	0.000	7818	0.986	0.116	0,1
Cactus	7803	0.916	0.277	15	0.667	0.488	7818	0.916	0.278	0,1
President	7793	0.936	0.245	25	0.920	0.277	7818	0.936	0.245	0,1
Vice President	7801	0.541	0.498	17	0.412	0.507	7818	0.541	0.498	0,1
Date: Month	7806	0.945	0.229	12	0.667	0.492	7818	0.944	0.230	0,1
Date: Day	7806	0.779	0.415	12	0.667	0.492	7818	0.778	0.415	0,1
Date: Year	7806	0.942	0.234	12	0.833	0.389	7818	0.942	0.235	0,1
Date: day of week	7806	0.951	0.216	12	0.833	0.389	7818	0.951	0.217	0,1
Vocabulary Sum Score	195	5.226	2.106	1	0.000	---	196	5.199	2.133	0-10
Self-rated memory	16468	3.004	0.943	15	3.600	0.828	16483	3.005	0.943	1-5
Memory compared to past	16466	2.161	0.451	17	2.000	0.612	16483	2.161	0.452	1-3

* FTF/TEL cases only

Table 20. Wave 15 – HRS 2020 Descriptive Statistics

Wave 15 HRS 2020	Non-Imputed cases			Imputed Cases			Total			Range
	N	Mean	Std Dev	N	Mean	Std Dev	N	Mean	Std Dev	
Immediate Word Recall (TEL/FTF)	12858	5.491	1.838	117	5.368	2.641	12975	5.490	1.847	0-10
Delayed Word Recall (TEL/FTF)	12768	4.531	2.150	207	2.671	2.859	12975	4.501	2.175	0-10
Immediate Word Recall (WEB)	1991	6.243	1.837	36	5.639	2.748	2027	6.232	1.858	0-10
Delayed Word Recall (WEB)	1936	5.367	2.102	91	4.385	2.398	2027	5.323	2.125	0-10
Serial 7s	14741	3.598	1.625	261	2.115	1.608	15002	3.572	1.637	0-5
Backwards Count from 20*	12921	1.846	0.530	54	1.241	0.799	12975	1.843	0.532	0,1,2
Backwards Count from 86										0,1,2
Scissors	7350	0.986	0.119	12	1.000	0.000	7362	0.986	0.119	0,1
Cactus	7345	0.926	0.263	17	0.706	0.470	7362	0.925	0.263	0,1
President	7344	0.958	0.201	18	0.944	0.236	7362	0.958	0.201	0,1
Vice President	7344	0.681	0.466	18	0.444	0.511	7362	0.680	0.466	0,1
Date: Month	7350	0.956	0.205	12	0.833	0.389	7362	0.956	0.205	0,1
Date: Day	7350	0.807	0.395	12	0.583	0.515	7362	0.806	0.395	0,1
Date: Year	7348	0.963	0.188	14	0.643	0.497	7362	0.963	0.190	0,1
Date: day of week	7350	0.961	0.195	12	0.917	0.289	7362	0.960	0.195	0,1
Vocabulary Sum Score	149	5.376	2.241	7	6.571	3.910	156	5.429	2.334	0-10
Self-rated memory	14976	2.987	0.929	26	3.077	1.129	15002	2.987	0.929	1-5
Memory compared to past	14965	2.158	0.448	37	1.946	0.468	15002	2.157	0.448	1-3

* FTF/TEL cases only

Table 21. Correlation between Cognitive Score and Whether Any Values were Imputed

	HRS92	HRS94	AHD93	AHD95, HRS96	HRS98	HRS00	HRS02	HRS04
	W1	W2	W2	W3	W4	W5	W6	W7
Word Recall	-.05	-.04	-.27	-.27	-.21	-.21	-.17	-.17
Total Cognition	n/a	n/a	-.38	-.35	-.29	-.32	-.24	-.25
	HRS06	HRS08	HRS10	HRS12	HRS14	HRS16	HRS18	HRS20
	W8	W9	W10	W11	W12	W13	W14	W15
Word Recall	-.17	-.17	-.19	-.20	-.17	-.17	-.14	-.14
Total Cognition	-.24	-.24	-.24	-.26	-.24	-.22	-.20	-.19

* FTF/TEL cases only

Table 22. Correlation between Cognitive Score and Number of Imputed Values

	HRS92	HRS94	AHD93	AHD95, HRS96	HRS98	HRS00	HRS02	HRS04
	W1	**W2**	**W2**	**W3**	**W4**	**W5**	**W6**	**W7**
Word Recall	-.03	-.02	-.19	-.20	-.14	-.15	-.13	-.11
Total Cognition	n/a	n/a	-.27	-.26	-.18	-.23	-.20	-.18
	HRS06	**HRS08**	**HRS10**	**HRS12**	**HRS14**	**HRS16**	**HRS18**	**HRS20**
	W8	**W9**	**W10**	**W11**	**W12**	**W13**	**W14**	**W15**
Word Recall	-.12	-.11	-.13	-.14	-.12	-.11	-.08	-.09
Total Cognition	-.17	-.16	-.18	-.17	-.16	-.15	-.11	-.12

* FTF/TEL cases only

Summary of Cognitive Imputations Data

Imputations of cognitive variables were performed using the steps and procedures described earlier in this report. A single merged data set has been constructed to include all respondents across all waves for respondents who completed at least one self-interview. The file contains the primary identifiers HHID (Household ID) and PN (Person Number), cognitive variables, and flag variables indicating whether a cognitive variable value was imputed or not.

Variable Naming conventions

Variables were named based on the RAND data naming conventions. All variables are at the respondent level, and therefore begin with the letter R. The second letter indicates the wave (e.g., W1, W2, W3, etc.). An F following the wave indicates that the variable is a Flag variable, identifying whether a particular score was imputed or not. The remaining letter combination reflects the item content. For example, R1IMRC indicates a respondent's Wave 1 immediate recall score. R1FIMRC indicates a flag for whether R1IMRC was imputed (1=Imputed, 0=Not Imputed, 2=Not Imputed-missing by design).

Summary Scores

There are three sets of summary scores in the file:

1. **Total Word Recall.** A total recall variable (R1TR40, R2ATR20, R2HTR40, R3TR20, R4TR20, R5TR20, etc.) for each wave was calculated that includes a composite score of the word recall items (immediate recall score + delayed recall score). Scores for the composite word recall variable range from 0 to 20 for all waves except HRS 92 and 94, for which scores range from 0 to 40 because the task was based on a 20-item (rather than 10-item) word list.

2. **Mental Status.** The Mental Status items (serial 7s + backwards count from 20 + object naming (scissors & cactus) + President naming + Vice President naming + date naming (month, day, year, day of week) were added together to create a composite score across all of the mental status items (R2AMSTOT, R3MSTOT, R4MSTOT, R5MSTOT, etc.) . Scores range from 0-15. The backwards count from 86 item was not included since it was not asked across all waves. There is no summary variable for Wave 1 or Wave 2H (HRS 1994) because the mental status (TICS) items were not asked in those waves.

3. **Total Cognition.** A summary variable including word recall and mental status items is also included in the file. This variable has a possible range of 0-35, and includes immediate recall (0-10), delayed recall (0-10), serial 7s (0-5), backwards count from 20 (0-2) + object naming (scissors & cactus; 0-2) + President naming (0-1) + Vice President naming (0-1) + date naming (month, day, year, day of week; 0-4). The summary variables names are R2ACOGTOT, R3COGTOT, R4COGTOT, R5COGTOT, etc.) There is no

R1COGTOT or R2HCOGTOT since the mental status items (TICS) were not asked in those waves.

For additional information concerning the measurement properties (including reliability and factor structure) of the items, please refer to Ofstedal et al. (2005) or McArdle, Fisher, & Kadlec (2007).

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