HRS/AHEAD Documentation Report

*Documentation of Cognitive Functioning Measures
in the Health and Retirement Study*

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Product of the HRS Health Working Group

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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. In the cohort of oldest-old represented in AHEAD, cognitive decline and particularly onset of cognitive impairment may lead to inadequate functioning in daily life. For example, adequate cognitive functioning is required to perform Instrumental Activities of Daily Living (IADL), such as managing money and paying bills, following complex medical regimens, or planning sequences of activities (Fillenbaum et al., 1988). Similarly, well-learned ADLs such as dressing, bathing, or eating depend on cognitive functioning, although to a lesser extent than IADL's (Park, 1999; Reed, Jagust, & Seab, 1989). Limitations in these abilities may have economic consequences in the form of reduced efficiency in taking care of financial affairs or increased expenditures associated with needed formal health care and informal personal assistance.

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 reasons for this are complex. Park (1999) discusses a number of possible explanations including the fact that experienced-based or acquired knowledge declines less with increasing age, compensating for processing limitations, and that everyday behaviors are familiar and largely automatic processes. According to Park, decision making in novel areas such as retirement and pension planning or selection of health insurance plans would be expected to be more heavily affected by the cognitive declines associated with age. In sum, the implications of cognitive functioning and its changes for people's daily lives as they age are complex and not well understood. One reason is the lack of adequate data sources from which to derive population-based estimates of cognitive impairment and with which to study a broad set of relevant outcome information. For these reasons, cognitive functioning was considered a critical dimension for conceptualization and measurement in the HRS/AHEAD study.

In developing cognitive measures for the HRS/AHEAD, little guidance was available from the existing literature or other large-scale surveys. Rarely, if ever, had cognition been measured in the less controlled setting and larger scale of a national survey. The development of the measures was coordinated by the HRS Health Working Group, chaired by Robert Wallace, and drew on the expertise of many cognitive psychologists, gerontologists, geriatricians, and psychiatrists.

Persons who formally provided consultation on the cognitive measures (and their affiliations at the time they provided the consultation) include:

John Breitner, Johns Hopkins University
Gerda Fillenbaum, Duke University
Barry Fogel, Brown University
Chris Hertzog, Georgia Institute of Technology
David Hultsch, University of Victoria
Ulman Lindenberger, Max Plank Institute in Berlin
Denise Park, University of Michigan
Tim Salthouse, Georgia Institute of Technology, and
Anderson Smith, Georgia Institute of Technology.

The development of the HRS/AHEAD cognitive measures derived from two major bodies of literature -- the writings on intelligence and cognition in psychology (particularly the psychology of aging), as well as the geriatric and neurological writings on cognitive impairment and dementia. From the psychology of aging literature, it seems clear that learning and memory skills decline gradually with increasing age (Colsher and Wallace, 1991; Hultsch et al., 1992; Poon, 1985). The geriatric literature further suggests that learning and memory problems represent some of the earliest and core signs of dementia (Ashford et al., 1989; Masur et al, 1994; Welsh et al, 1992). Thus, a test of learning and memory was deemed important for HRS/AHEAD.

The geriatric literature also describes other dimensions of cognitive functioning represented in many mental status questionnaires (Roth et al., 1986) such as basic, well-established skills of reasoning, orientation, calculation, language, and knowledge. These skills appear to be disrupted at a later stage in the dementia process (Ashford et al., 1989). Likewise, some of the psychological literature suggests a less precipitous decline for some well-established abilities of knowledge and reasoning (Horn, 1987), although the evidence is not entirely consistent (Schaie and Hertzog, 1983). Tests of knowledge, reasoning, orientation, calculation, and language seemed to be important for HRS/AHEAD because (a) they may help to compensate for the declining processing resources, and (b) when they also decline, they may predict a person's need for assistance with the more basic activities of daily living (Reed et al., 1989; Weiler, Chiriboga and Black, 1994).

Recent research has shown a concerted effort to identify the basic cognitive functions underlying the various cognitive abilities. A cogent conceptualization of cognitive functioning that integrates much of the research on aging and cognition is spelled out by Perlmutter (1988). She postulates a three-tiered model, which consists of the basic mechanisms or processing resources in Tier 1, the knowledge base in Tier 2, and the thinking and strategies in Tier 3. Tier 1 is often referred to as "fluid intelligence" and is most closely linked to biological and physical processes; as such, it tends to show the clearest decline in older age. Salthouse (1999) refers to this component as "process." One important aspect of process is the speed with which many processing operations can be executed (Salthouse, 1996). Another aspect is reflected in the concept of working memory (Craik, 1999) or the ability to process information and store it simultaneously. Tier 2, often referred to as "crystallized intelligence," is based on formal

education and informal experience and tends to decline less clearly as people get older. Salthouse (1999) terms this component "product." Perlmutter's Tier 3 contains strategies for dealing with knowledge and with one's own cognitive resources and is most closely related to the concept of metacognition or metamemory. Metacognition or metamemory refers to what individuals know and believe about their own cognitive abilities or memory (Dixon, Hertzog, and Hultsch, 1986; Dixon, 1989). As an adaptive resource, Tier 3 may continue to grow throughout life.

Learning and memory, along with abstract reasoning and thinking, makes use of the basic functions in different combinations and to different degrees. For example, it has been argued that the age-related decline in learning and memory is primarily a function of age-related decline in speed and efficiency of information processing or Tier 1 capabilities (Lindenberger, Mayr and Kliegl, 1993; Park, 1995; Salthouse, 1985).

It is difficult to find complete consensus on what the important dimensions for a study of the aged ought to be, because the field is undergoing rapid development. Studies that attempt to capture a broad representation of cognition, such as the Swedish Twin Study of Aging (Nesselroade et al., 1988) or the community study in Australia (Christensen et al., 1994) often organize their measures into fluid intelligence, crystallized intelligence, and memory. Some of the standard intelligence tests are relatively pure measures of one or the other dimension, while other tests draw on several of the dimensions. Geriatric dementia screens such as the Mini-Mental State Exam (Folstein, Folstein, and McHugh, 1975) or the Short Portable Mental Status Questionnaire (Pfeiffer, 1975) often contain brief tests of a number of dimensions.

Another important measurement issue for HRS/AHEAD was providing differentiation across a fairly wide age range and a wide variety of cognitive functioning measures. Whereas some older persons demonstrate considerable difficulties in performing even basic cognitive tasks, others continue functioning at an unimpaired level. Being able to describe both extremes without ceiling or floor effects represented a major challenge for the development of HRS/AHEAD measurements. The chosen approach included measuring components of various difficulty levels, thereby not only building on but also expanding existing scales.

Several specific objectives underlie the selection of cognition measures for the HRS/AHEAD. First, we are interested in the impact of cognitive performance and cognitive decline on health, daily functioning, retirement, economic and health decision-making, and ultimately the use of economic and social resources. For this first purpose we desired a measure that represents the major dimensions of cognitive functioning and differentiates across the full range of cognitive abilities, including the higher functioning end. Second, we are interested in identifying respondents who experience cognitive impairment. For this second purpose we sought a measure that looks like the traditional mental status measure and is able to provide differentiation at the low functioning end of cognitive abilities. Third, we hope to be able to screen for early signs of dementia as well as tracking its subsequent progression.

The design of the HRS/AHEAD 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/AHEAD 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. As a result, HRS/AHEAD 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. The measure of change is particularly important because rate of decline rather than absolute level may be the critical indicator of dementia (Jorm and Jacomb, 1989).

In sum, the HRS/AHEAD cognitive measures were selected to satisfy the following considerations:

(a)   provide descriptive information on a comprehensive range of cognitive functions;
(b)   span all difficulty levels from competent cognitive functioning to cognitive impairment;
(c)   be sensitive to change over time;
(d)   be administrable in a survey environment with lay interviewers, over the telephone, in a short time; and
(e)   be valid and reliable.

II.   Inventory of Measures and Cross-Wave Comparison

In keeping with the considerations outlined in the previous section, HRS/AHEAD contains the measures of cognitive functioning described below. What follows is a description of the various cognitive functioning measures and notes regarding how questions have changed in HRS/AHEAD across waves. Tables 1 and 2 provide a concordance table listing which questions were asked in which wave among self and proxy respondents, respectively. Table 3 (at the end of this document) lists the variable names for each of those questions in the dataset. For more detail regarding exact question wording, skip patterns, and response coding, refer to the questionnaires and codebooks.

A. Self-respondent Measures

Memory

Two questions were asked about respondents' self perceptions about memory and memory change.

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 HRS/AHEAD Waves (93, 95, 96, 98, 00, 02, & 04)
"How would you rate your memory at the present time?"
"Would you say it is excellent, very good, good, fair, or poor?"

Self-rated Memory (compared to past)

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 HRS/AHEAD Waves (93, 95, 96, 98, 00, 02, & 04)
"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?"

Memory was assessed using two word list recall tasks (immediate free-recall and delayed free recall):

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 HRS/AHEAD Waves (93, 95, 96, 98, 00, 02, & 04)
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 word 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.

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.

We assessed respondents' working memory using the Serial 7's subtraction test:

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.

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.

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, HRS 96, and HRS/AHEAD 98, 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 item was discontinued in HRS 2004 when major efforts were undertaken to reduce the amount of time taken for the survey. Discontinuing This item does not affect an analyst's ability to calculate a TICS summary score because the backwards count from 20 but not the backwards count from 86 item is used in that calculation.

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 respondents 65 years of age and older, or of respondents who had not been interviewed in a prior wave.

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 respondents 65 years of age and older, or respondents who had not been interviewed in a prior wave.

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 respondents 65 years of age and older, or of respondents who had not been interviewed in a prior wave.

Abstract Reasoning

Similarities

In HRS 92 and 94, a modified similarities test from the Wechsler Adult Intelligence Scale-revised (WAIS-R) was used to assess higher level, abstract reasoning. Respondents were each given seven pairs of words and asked to describe the way in which the items are alike: orange and banana, table and chair, eye and ear, egg and seed, air and water, fly and tree, and praise and punishment. In HRS 92, this test was included for all respondents; in HRS 94, this test was administered in an experimental module that was presented to a random subset of about 650 respondents. This measure was also administered as part of a module in AHEAD 93; however, the similarities measure in AHEAD 93 consisted of 6 word pairs instead of seven: orange and banana, dog and lion, eye and ear, egg and seed, air and water, and fly and tree. Compared to the seven items in HRS, "praise and punishment" was not asked, and "dog and lion" was asked although "table and chair" was not.

Fluid Reasoning

In HRS 2004 we assessed fluid reasoning with a number series test adapted from the Woodcock-Johnson (WJ-R) tests of cognitive ability. A more detailed description of the module is provided in Section III (p.15). Due to copyright restrictions on test material, we are unable to publish the exact items used in this module.

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 and later waves, 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.

Dementia

In HRS/AHEAD 98, a question was added to ascertain whether the respondent had ever been diagnosed with dementia. This question was asked in Section B (Health Status) as follows:

"Has a doctor ever told you that you have a memory-related disease?"

Numeracy

In HRS 2002, three questions were added to the core survey and a more lengthy module was conducted to assess numeracy (respondents' numerical ability):

"Next I would like to ask you some questions which assess how people use numbers in everyday life. If the chance of getting a disease is 10 percent, how many people out of 1,000 would be expected to get the disease?"

"If 5 people all have the winning numbers in the lottery and the prize is two million dollars, how much will each of them get?"

"Let's say you have $200 in a savings account. The account earns ten percent interest per year. How much would you have in the account at the end of two years?"

For the module items, see HRS 2002 Section V, starting with HV350.

B. Proxy Measures

The following section describes the cognitive functioning measures that were asked of proxy respondents in HRS/AHEAD beginning with AHEAD 93 and HRS 96. There were no cognitive functioning questions asked of proxy respondents in HRS 92 or HRS 94.

Global Ratings

Two questions were asked of proxy respondents to assess respondents' overall memory and change in memory compared to the prior wave.

Memory Rating (present)

"How would you rate (R's first name)'s memory at the present time?"
"Would you say it is excellent, very good, good, fair, or poor?"

Memory Rating (compared to past)

This question was only asked in AHEAD 93 and HRS/AHEAD 98. In HRS/AHEAD 98, it was only asked of proxies for whom the subjects they were reporting about were younger than 65 years of age. Note that the wording for this question differed between these two waves. Refer to the codebook for details.

In addition to rating respondents' memory, proxy respondents rated respondents' behavior in terms of overall judgment and organization of daily life. In HRS/AHEAD 98 and later waves, these remaining questions were only asked for subjects 65 years of age and older or those under age 65 who had not been interviewed in a prior wave.

Judgment

"How would you rate (R's first name) in making judgments and decisions?"
"Would you say that (he/she) is excellent, very good, good, fair, or poor?"

In addition to rating the respondent's current judgment ability, in AHEAD 93, proxy respondents were asked to rate the amount of change they have noticed over the past 2 years.

Organization

"How would you rate (R's first name)'s ability to organize (his/her) daily activities?"

In addition to rating the respondent's current organizational ability, in AHEAD 93, proxy respondents were asked to rate the amount of change they have noticed over the past 2 years.

Jorm IQCODE (16-item version)

Proxy respondents were asked 16 questions about the respondent's change in memory for various types of information with regard to change in the last two years. These questions are adapted from the short form of the Informant Questionnaire on Cognitive Decline in the Elderly (IQCODE; Jorm, 1994); the original version contained more items (Jorm and Jacomb, 1989). In HRS/AHEAD 98 and later waves, these remaining questions were

only asked for subjects 65 years of age and older or those under age 65 who had not been interviewed in a prior wave. These questions were worded as follows:

"Compared with two years ago, how is (R's first name) at remembering things about family and friends, such as occupations, birthdays, and addresses? Has this improved, not much changed, or gotten worse?"

Scoring for the IQCODE is included in the appendix.

The additional fifteen questions were asked in a similar manner pertaining to the respondent's change in ability for:

- Remembering things that have happened recently
- Recalling questions a few days later
- Remembering (his/her) address and phone number
- Remembering what day and month it is
- Remembering where things are usually kept
- Remembering where to find things that have been put in a different place than usual
- Knowing how to work familiar machines around the house
- Learning to use a new gadget or machine around the house
- Learning new things in general
- Following a story in a book or on TV
- Making decisions on everyday matters
- Handling money for shopping
- Handling financial matters, that is, the pension or dealing with the bank
- Handling other everyday arithmetic problems, such as knowing how much food to buy, knowing how long between visits from family or friends
- Using (his/her) intelligence to understand what's going on and to reason things through

Behavior Problems

Proxy respondents also reported on the frequency with which they have observed a variety of behavior problems. In HRS/AHEAD 98 and later waves, these questions were only asked for subjects 65 years of age and older or those under age 65 who had not been interviewed in a prior wave. These questions were worded as follows:

- "Now, thinking about some current behaviors, does (R's first name) ever get lost in a familiar environment?"
- "Does (R's first name) ever wander off and not return by (himself/herself)?"
- "Can (he/she) be left alone for an hour or so?"
- "Does (R's first name) ever see or hear things that are not really there?"

- "During the past week, how often has (R's first name) become angry or hostile without reason? Was it most of the time, some of the time, or never?"

"In addition, how often has (R's first name)…
- Had difficulties falling asleep or waking frequently during the night?
- Done things that are dangerous to (himself/herself) or others?
- Paced around or made unexplained rocking movements while sitting
- Mentioned that people are plotting against or trying to harm (him/her)?
- Drunk too much alcohol?"

Table 4, below, provides a brief summary of the measures that are included specific waves of HRS and AHEAD. Tables 1 through 3 at the end of this document provide much more detail on the question numbers and variable names for individual questions in each wave.

Table 4								
Cognitive Functioning Measures included in Different Waves of Core HRS/AHEAD								
Measure	**HRS 92**	**AHEAD 93**	**HRS 94**	**AHEAD 95**	**HRS 96**	**HRS 98**	**HRS 00**	**HRS 02**	**HRS 04**
Self-respondent tests									
Immediate recall (20-item)	X		X						
Immediate recall (10-item)		X		X	X	X	X	X	X
Delayed recall (20-item)	X		X						
Delayed recall (10-item)		X		X	X	X	X	X	X
Serial 7's subtraction		X		X	X	X	X	X	X
Mental status items		X		X	X	X	X	X	X
WAIS-Similarities	X	X							
WAIS-Vocabulary				X	X	X	X	X	X
Numeracy								X	X
Number Series									X
Rating of memory	X	X	X	X	X	X	X	X	X
Proxy ratings									
Global ratings		X		X	X	X	X	X	X
Behavior problems		X		X	X	X	X	X	X
Jorm IQCODE				X	X	X	X	X	X
Report of dementia diagnosis						X	X	X	X

III.   Pedigree/Origin of Cognitive Functioning Measures

In HRS/AHEAD we used a multidimensional measure of cognitive functioning, based upon a telephone screen named the Telephone Interview for Cognitive Status or TICS (Brandt, Spencer and Folstein, 1988), which was modeled after the Mini-Mental State Exam (Folstein, Folstein, and McHugh, 1975) for use over the telephone.

HRS/AHEAD uses a reduced version of the TICS that was also used by Breitner and colleagues (Breitner, Welsh, Gau, McDonald, & Steffens, et al. 1995) in a clinical study of dementia. In addition to dropping some items from the original TICS, other changes were also implemented beginning in AHEAD 95 and HRS 96. These included the use of four different noun lists for the word recall tests in order to be able to alternate lists over waves and administer different lists to respondents in the same household; instructions to count backwards as quickly as possible in order to fashion the counting backwards into a purer measure of information processing speed; and the use of two trials for counting backwards in order to increase the reliability of this particular measure. The original 10-noun list used in AHEAD 93 was taken from the Iowa Established Populations for Epidemiological Study of the Elderly (EPESE) study. The new forms used in subsequent waves were constructed in an equivalent manner (described in Section IV.A below).

Proxy respondents were asked 16 questions about the respondent's change in memory for various types of information with regard to change in the last two years. These questions are adapted from the short form of the Informant Questionnaire on Cognitive Decline in the Elderly (IQCODE; Jorm, 1994); the original version contained more items (Jorm and Jacomb, 1989).

A vocabulary test was used as a supplement to the TICS measures to provide a more pure measure of crystallized intelligence. Two different forms, comprised of five words each, were culled from the Wechsler Adult Intelligence Scale-revised (WAIS-R) vocabulary test.

The numeracy questions in the core in HRS 02 and 04 were included in the ELSA survey and adapted by HRS. The first of the three numeracy items was adapted from Lipkus, Samsa, and Rimer (2001). The remaining two items were developed by one of the ELSA co-investigators: Professor Felicia Huppert at the University of Cambridge. The numeracy questions in the 2002 module were developed by a committee of researchers at the University of Michigan, including Peter Ubel, Angela Fagerlin, David Weir, Ken Langa, and Gwenith Fisher.

Number Series Module in HRS 2004

In April 2003 HRS investigators consulted with John J. McArdle (University of Virginia), John L. Horn (University of Southern California), and Richard W. Woodcock (Measurement Learning Consultants) about the development of an abbreviated version of tests from the of the Woodcock-Johnson III Cognitive Ability Battery for administration as part of HRS 2004 and beyond. This led to a definition of the multiple abilities that could be considered and a list of potential WJ-II tests that could be administered as part of any short telephone or face-to-face measurement survey.

In June 2003 HRS investigators in consultation with McArdle created a rigorous definition of a survey presentation of the 47-item Number Series task from the new WJ-III. The purpose of this module was to broaden the content domain currently assessed in the HRS to include "fluid intelligence" (*Gf*), and to conduct a pilot test to determine the feasibility of administering an abbreviated test form in HRS.

A random sub-sample of current HRS respondents was selected to complete this new number series module (N=1039). The time allotted for the module was three minutes, and the test was designed so that each respondent would be asked approximately six test items (i.e., the number of items that could be completed in the three-minute time frame). Given the limited possible number of items that could be administered, one goal of the test was to estimate the respondents' ability level using as few items as possible. Using adaptive testing methodology, a correct response to an item would be followed by a more difficult test item, whereas an incorrect response would be followed by an easier item. This sequencing of items and item difficulty ideally continues until a respondent has a 50/50 chance of getting an item correct.

We identified four possible starting points for the number series module. The starting point for a given respondent was based on the number of years of education (0-17) and their performance on the Serial 7s subtraction task. Specifically, college-educated respondents with a perfect score on the Serial 7s task would start with a more difficult test item than a respondent with less education and/or a lower score on the Serial 7s task.

We computed composite scores for all respondents based on the scoring method for the original WJ-III test. Scores are indicated by percentages and represent the likely percentage of items correct if the respondent had been administered all 47 items on the original test.

IV.   Special Methodological Issues

A.   Age Eligibility

1.   Age-eligibility for HRS/AHEAD Study

The desire of the HRS surveys to collect information on both spouses of a married couple has lead to two mutually exclusive groups – those age-eligible for the survey, and those who are spouses of an age-eligible respondent but are not age-eligible themselves. The initial wave of HRS sampled households with at least one individual born between 1931 and 1941 and also interviewed the spouse when the originally sampled individual was married, regardless of the spouse's birth year[1]. Consequently, some households contain all age-eligible respondents whereas other households contain both an age-eligible and a not-age-eligible respondent.

It is important to note that the not-age-eligible respondents are not a random sample representative of their age cohort. Rather than being chosen at random, they were sampled

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[1]Likewise, the AHEAD study sampled households with at least one individual born in 1923 or earlier and also interviewed their spouse, if married, who would not be age-eligible if born in 1924 or later.

because they were married to an age-eligible person. In the HRS, not-age-eligible respondents born before 1931 (therefore older than the HRS cohort) tend to be the male husbands of age-eligible female respondents. Those not-age-eligible respondents born in 1942 or later (therefore younger than the HRS cohort) tend to be female (the wives of HRS-age-eligible male respondents). Including these not-age-eligible respondents in an analysis can lead to biases. Therefore, the individual-level sampling weights on the HRS and AHEAD files are zero for not-age-eligible respondents. However, in unweighted analyses, the researcher must be careful to account for this conditionally selected group. Excluding these individuals is recommended. Hence, only age-eligible respondents are included in the tabulations that appear in this paper.

2. *Age-eligibility for Cognitive Measures*

Measures of cognitive functioning in AHEAD are intended to differentiate a more impaired study population than the younger, pre-retirement HRS cohort. AHEAD retains the general HRS focus on tests of learning and abstract reasoning -- the latter in an experimental module -- but adds measures of orientation and attention as typical in geriatric mental status questionnaires.

Beginning with HRS 98, when HRS and AHEAD were fully integrated, an age screen was used to determine which cognition measures would be administered. Specifically, in each wave from HRS 98 forward, all respondents 65 years of age and older received the full set of performance tests or proxy measures that were previously asked only in AHEAD. In addition, all new respondents in a given wave (i.e., new spouses and/or new cohort members) were asked the full set of questions in their baseline interview; however, in previous waves they then follow the age skip along with other respondents. Re-interviewed respondents under 65 years of age received the two questions on self-assessed memory (present rating and change), immediate and delayed recall tests, backwards count, and Serial 7s subtraction. Proxy respondents for re-interviewed respondents under age 65 are asked only to assess the subject's memory at present and compared to the last interview.

B. Learning Effects

Longitudinal or prospective surveys represent the most powerful designs for describing change and for investigating the causal linkages between cognitive performance and its precursors and consequences. Standard survey techniques suggest that identical questions be asked at each wave of a longitudinal survey in order to avoid confounding measurement change with substantive change (Cook & Campbell, 1979). However, this technique is inopportune when the measure is a memory or even a knowledge test because repeated exposure may improve performance over time.

In the HRS, we found that the average number of nouns recalled from a list of 20 nouns increased by an average of about one half of a noun when the same list was presented again two years later. Part of the improvement in memory performance over time is likely to be due to the mere experience with the nature of the task that cannot be controlled, but part of it is likely to be due to the learning of the specific material. In order to control for the experience with the specific material, we constructed lists that contained different but equivalent nouns for an

immediate and delayed free-recall task, as well as for the vocabulary task, in AHEAD 95 and later waves.

With regard to the recall task, following the rules of construction used for the single 10-noun list in AHEAD 1993, we selected one- and two-syllable nouns of high frequency (AA according to Thorndike and Lorge, 1944, except for one A noun per list) and high imagery and concreteness (6.0 or more according to the norms by Paivio, Yuille, and Madigan, 1968). Nouns satisfying these conditions were then ordered by recall-ability according to the norms by Rubin and Friendly (1986) and distributed to form six lists. We submitted each form to a random subset of about 30 respondents in a telephone pretest.

The four lists selected for maximum equivalence in the pretest were then assigned to respondents in counterbalanced order over the next four AHEAD waves such that (a) each respondent received each form only once over four waves, (b) each form will appear equally often in each wave, and (c) each form will follow each other form equally often at each wave. In order to maintain the counterbalanced ordering, the lists are assigned according to survey waves rather than completed interviews, so that respondents who miss an interview wave will skip the form that was assigned for that wave. Data from the first administration of the four counterbalanced forms in AHEAD 95 indicate that the four forms differ minimally from each other (see Table 3 in Herzog & Rodgers, 1999), which is particularly impressive given the large sample sizes of about 1,500 respondents per form.

When we compared AHEAD 1993 data (using one recall list) with AHEAD 1995 data (using the four different but equivalent lists) for respondents who participated in both waves, unlike for the HRS we found no average improvement. The lack of improvement, of course, could also be due to the older age of the AHEAD than the HRS respondents. We will be able to assess the importance of the manipulation more directly using data from future waves of HRS and AHEAD.

With respect to the vocabulary task, two different lists of words were used to ensure that respondent couples did not receive the same set of words in AHEAD 95. The lists will be rotated in subsequent waves so that respondents receive different word lists in adjacent waves. (Analysis is underway to determine the equivalence of the two lists.)

Another complication arises in longitudinal studies when questions refer to generally available information in order to test orientation or tertiary memory. If the requested information remains the same, respondents learn. An example from the AHEAD survey is that respondents remembered the requested definition of scissors and cactus. If the requested information changes over time, longitudinal changes are confounded. A prime example is the question about the name of the president and the former president of the US contained in many cognitive screens. We observed a particularly telling example in another study: In 1986 when we conducted the first wave of the Americans' Changing Lives (ACL) study, former president Carter was not well remembered because then-president Reagan was in his second term and Carter had had only one term as president. In 1989, when we conducted the second ACL wave, former president Reagan was better remembered because then-president Bush had just recently come into office, and

Reagan had been president before him for two terms. These issues need to be remembered when using data that relates to real life information for longitudinal investigations.

Recently, Rodgers, Ofstedal, & Herzog (2003) examined cohort-level trends in cognitive scores across four waves of HRS/AHEAD (from 1993 to 2000) and concluded that there was little improvement in cognitive functioning across the cohorts. Rodgers et al. (2003) examined the impact of prior exposure (practice) and found small (but significant) differences due to practice effects.

C.   Standardization of Test Administration

Surveys are usually taken in respondents' homes by many different interviewers. Standardization of test administration is difficult in this situation. Despite careful training, interviewers may vary in exactly how they ask the survey questions and how they administer the cognitive tests, and the home environment may vary in how well it facilitates or interferes with the successful completion of the survey process. To illustrate, two brief examples are reported -- the presentation of the nouns for the free-recall test and the effect of overhearing test performance by another respondent in the household.

1.   *Word List Recall Test Administration*

For the free-recall test we trained about 100 interviewers of the HRS and AHEAD to read the 10 nouns at a rate of 2 seconds per noun and impressed on the interviewers not to read any of the nouns more than once. In order to set up proper expectations among the respondents, we included these specifications in the standardized instruction to be read to the respondent. We checked the level of standardization of interviewer behavior achieved for the free recall test by tape-recording and coding of more than 60 (63) interviews randomly chosen across interviewers and study period.

The analysis showed (a) that most interviewers spent between 14 and 26 seconds reading the 10 nouns and (b) that about one quarter of them were asked to repeat or explain a word, a request that most of them honored. In fact, most outliers of time beyond the range of 14 to 26 seconds can be explained by interruptions caused by such a request. In order to minimize repetition of words and standardized administration time, the nouns are now presented in a timed fashion paced by the computer; this change was implemented in the HRS/AHEAD 98.

2.   *Interviews with Both Spouses*

The second example of a standardization problem stems from the HRS/AHEAD design, which calls for both spouses to be interviewed. Because the AHEAD surveys older persons who are largely retired, both spouses are often found at home and cannot always easily be separated for the conduct of the interview. We suspected that the one spouse overhearing the cognitive testing of the other might have an unfair advantage. This is also a concern for the HRS cohort, but may be less acute since many of those cohort members and their spouses are still working. As a result, the likelihood of both spouses being home during the interviews is smaller.

When we compared the cognitive performance of the spouses who were interviewed first with that of those interviewed second, we found supporting evidence for our suspicion (see Table 4 in Herzog & Rodgers, 1999). In AHEAD 93, an advantage for the second respondent was evident for the delayed recall and the Serial 7s tests in the face-to-face situation. In the telephone situation -- where overhearing is not as likely -- the second respondent appeared to be disadvantaged (except in the Serial 7s test), which is consistent with our informal observations that the less healthy spouse will often be interviewed last.

In AHEAD 95, we attempted to minimize this contamination between spouses by including the spouses explicitly in the counterbalancing assignment such that spouses never got the same noun list in the same or even adjacent survey waves. Data for the free-recall tests in AHEAD 95 show that our procedure worked: the second spouse now performs worse (see Table 4 in Herzog and Rodgers, 1999). Note that the second spouse still performs better in the Serial 7s and the mental status tests that remained identical for both spouses.

D.   Mode Effect: Telephone vs. Face-to-face Interviews

Telephone surveys have become very popular because of cost advantages. A number of studies do not find any major differences in data quality between telephone and face-to-face surveys (e.g., Groves & Kahn, 1979). Nevertheless, concerns for telephone surveys of the elderly persist and are particularly prevalent with respect to cognitive tests which require a well-controlled and closely supervised administration and for which hearing difficulties could prove critical.

In order to test formally the effect of mode of administration on cognitive measures, a full mode experiment was built into the second wave (1995) of the AHEAD study in the following form. The original AHEAD design calls for a switch from a telephone to a face-to-face administration when a respondent turns 80. In the second and third wave of the AHEAD (95 and 98, respectively), respondents in the transition age range of 78 through 81 were randomly assigned to either a telephone or a face-to-face administration. In other words, one random half of respondents made the transition to a face-to-face survey administration a wave earlier than the other random half, providing for an experimental manipulation of the mode assignment. The average cognitive scores obtained from respondents assigned to the telephone mode and those assigned to the face-to-face mode do not differ significantly (see Table 5 in Herzog and Rodgers, 1999), indicating no reliable performance differences between respondents in telephone and face-to-face assignments. These analyses provide evidence that the AHEAD cognitive performance scores are not affected by whether they are collected over the telephone or face-to-face.

E.   Use of Proxy Respondents

Most proxy interviews are designated as such at the outset. That is either the respondent him/herself or a gatekeeper (most often a spouse or other family member) indicates prior to the start of the interview that the respondent is unable to participate in the interview. In this case, a proxy respondent is identified immediately and the interview is conducted with that person. In a few cases, however, the respondent is willing to be interviewed, but there are concerns about

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his/her ability to provide accurate information. Specifically, if a respondent performs extremely poorly on the cognition items, the interviewer is prompted to either find another person to assist the respondent with the remainder of the interview or to switch to a proxy interview. In practice this advice was not always followed, often because the interviewer was unable to identify an appropriate person to serve as an assistant or proxy informant.

Further information on the use and selection of proxy respondents and details of the scoring algorithm for the proxy/assistant flag are provided in the general documentation at the following web location:

http://hrsonline.isr.umich.edu/intro/sho_intro.php?hfyle=uinfo

Whereas proxy answers are usually substituted for respondent answers to survey questions that deal with facts and opinions, it is not obvious how they may substitute for cognitive performance tests. We used the IQCODE scale developed by Jorm and his colleagues in HRS/AHEAD (Jorm, 1994; Jorm and Jacomb, 1989). This scale asks the informant to judge the eligible respondent on many aspects of memory and intelligence. Jorm's studies have shown that the scale differentiates those who are diagnosed as demented from those not so diagnosed (Jorm, 1994; Jorm and Jacomb, 1989). Using Jorm's scoring, 412 or about 46% of respondents were identified as likely demented among AHEAD 95 respondents who were reported on by a proxy. This suggests that poor cognitive functioning is an important reason for a proxy response.

V.   Evaluation of data quality

A.   Univariate Distributions

Tables 5 to 9 (at the end of this report) present descriptive statistics for unimputed measures of cognitive functioning among self and proxy respondents for all waves of HRS and AHEAD through 1998. Table 5 includes unweighted frequencies for cognitive functioning items asked among self-respondents measured using categorical response scales. Weighted percentages for the same items are presented in Table 6. Weighted means and standard deviations for correct responses of continuous measures among self-respondents are included in Table 7. Tables 8 and 9 present the unweighted frequencies and weighted percentages, respectively, among proxy respondents. The sampling weights applied in the calculation of percentages and mean scores were designed to make the sample representative of the population based on demographic characteristics.

B.   Benchmarking Against Other Surveys

One way of evaluating data quality is to compare the distributions obtained in the HRS/AHEAD survey to that obtained for similar measures on other surveys. Because data on cognitive performance has rarely been collected in representative surveys, our ability to make such comparisons is limited. However, the table below presents comparisons for a limited set of cognition measures from three surveys: the 1993 AHEAD, 1986 Americans' Changing Lives Survey (ACL), and the 1982 Iowa Established Populations for Epidemiologic Studies of the Elderly Survey (EPESE). All results presented are among samples of respondents age 70 years and older.

Most of the items show remarkable consistency across surveys. One exception is the 'day of week' item, for which the ACL respondents scored somewhat lower than either the AHEAD or the Iowa EPESE respondents. There is also slight variation across the three surveys on the current president; however, of all the items examined here, this one is perhaps the most sensitive to period or timing effects (i.e., who is in office and length of time served).

Table 10			
Percent reporting correct response on selected items from mental status questionnaires: AHEAD 1993, ACL 1986, and EPESE 1982			
Item	**AHEAD 1993 (Age 70+)**	**ACL 1986 (Age 70+)**	**EPESE 1982**
Month	95.5%	96.5%	—
Day of month	78.8%	77.9%	—
Year	95.0%	97.2%	—
Complete date (exact month, day, and year)	76.1%	—	78.2%
Day of week	95.9%	91.0%	95.7%
Current President	90.6%	93.1%	92.5%

Note: AHEAD figures based on crude imputation. EPESE's cognition questions were only asked during in–person interviews; respondents to telephone interviews were not asked cognition questions.

C.   Internal Consistency and Measurement Properties

An important issue concerns whether the cognitive measures related to each other in a consistent fashion and whether the underlying construct of cognitive functioning represented one or several dimensions. Factor analysis was used to examine the structure underling the cognitive performance tasks. Specifically, a series of maximum likelihood exploratory factor analyses using an oblique rotation (which allowed the factors to be correlated as indicators of general cognitive ability) was conducted separately for each wave of HRS and AHEAD. The cognitive functioning items included in this analysis were immediate recall (scored from 0-10), delayed recall (scored from 0-10), Serial 7s (scored from 0-5), counting backwards beginning with 20 (scored from 0-2), month (scored 0-1), day (scored 0-1), year (0-1), day of week (0-1), name scissors (0-1), name cactus (0-1), name current President (0-1), and name current Vice President (0-1).

The results of this analysis yielded 3 factors: (1) a memory factor, consisting of immediate and delayed recall, (2) a date naming factor, consisting of month, day, year, and day of week, and (3) a mental status factor consisting of the remaining items. The naming scissors item did not perform consistently across waves, as there was almost no variability on this item (i.e., 99% of respondents answered this item correctly across all four waves of HRS and AHEAD).

A second series of factor analyses was conducted after constructing and substituting a summary variable for the four date items (the sum across all 4 items, with scores on the constructed variable ranging from 0-4), and removing the scissors item in the analysis. Results indicated that across waves, two factors with eigenvalues greater than one consistently emerged from the data: (1) a memory factor, comprised of the immediate and delayed recall scales and (2) a mental status factor, comprised of Serial 7s, counting backwards, dates, and word/name recognition. The two factors were moderately related to one another (r's ranged from .45 to .55 across the four waves). The table below shows the eigenvalues and percentage of variance accounted for by these two factors in each of the four waves.

	AHEAD 93 Unweighted N = 5772		AHEAD 95 Unweighted N = 4883		HRS 96 Unweighted N = 7540		HRS/AHEAD 98 Unweighted N = 11,188	
	Eigenvalue	Variance	Eigenvalue	Variance	Eigenvalue	Variance	Eigenvalue	Variance
Factor 1	2.7	33.5%	2.6	32.0%	2.3	28.4%	2.6	32.2
Factor 2	1.1	13.8%	1.1	14.0%	1.2	15.0%	1.1	14.2

Table 11
Eigenvalues and Variance Accounted for by Cognitive Functioning Factors

Note: Results are based on a maximum likelihood factor analysis with an oblique rotation with weighted and unimputed data among age-eligible self-respondents. HRS/AHD 98 analyses were conducted using the Early Release data

This finding of two distinct but related factors suggests two things: a composite or aggregate score of overall cognitive functioning may be formulated, but the separate components deserve a closer look in research investigations. One of the components represents the hypothesized memory factor. The other component, however, combines elements of fluid and crystallized intelligence, of process and of product. Factor loadings (item-factor correlations) are presented on the following page in Table 12.

	Table 12							
	Factor Loadings of Cognitive Functioning Items							
	AHEAD 93		AHEAD 95		HRS 96		HRS/AHEAD 98	
Item	Factor 1	Factor 2	Factor 1	Factor 2	Factor 1	Factor 2	Factor 1	Factor 2
Immediate Recall	.94		.95		.94		.89	
Delayed Recall	.79		.76		.76		.83	
Serial 7s		.43		.41		.45		.43
Counting Backward (20)		.29		.28		.19		.29
Dates		.46		.43		.20		.35
Name Cactus		.34		.30		.36		.35
Name President		.54		.53		.43		.50
Name Vice President		.57		.51		.58		.58

Note: Results are based on a maximum likelihood factor analysis with an oblique rotation with weighted and unimputed data among age-eligible self-respondents. HRS/AHD 98 analyses were conducted using the Early Release data

In addition to examining the dimensionality of cognitive functioning items based on the exploratory factor analysis, assessment of internal consistency reliability (coefficient alpha; Cortina, 1993) measures the extent to which items are interrelated and have high communalities. Coefficient alphas for the group of cognitive functioning items with and without the naming scissors item are presented in Table 13.

| Table 13 | | | | |
| Internal Consistency Reliability Coefficients (Alpha) for Cognitive Functioning Items | | | | |
	AHEAD 93	AHEAD 95	HRS 96	HRS/AHEAD 98
With Scissors Item	.64	.58	.58	.62
Without Scissors Item	.65	.65	.59	.63

Note: Alphas were calculated on weighted and unimputed data among age-eligible self-respondents. The date naming summary variable was used in this analysis. HRS/AHD 98 analyses were conducted using the Early Release data

The slightly lower alphas among the HRS respondents compared to AHEAD is likely due to the restricted variability in responses in HRS compared to AHEAD. In other words, there was less variability in cognitive functioning scores in HRS 96 compared to the other waves. This restricted variability serves to attenuate correlations among variables, which leads to lower estimates of internal consistency reliability.

D.   Construct validity

1.   *Past Research*

The greatest strength of the current HRS is in providing data for population-based estimates and norms for basic cognitive resources, especially regarding knowledge, attention, and memory losses useful in screening for dementias. The available HRS/AHEAD cognitive measurements can be useful in studies on the impacts of cognitive performance and decline in many substantive domains of interest. Using the current HRS data it is now possible to study how cognitive factors interact with physical and mental health, as well as practical matters of daily functioning, retirement, and the most cost-effective uses of economic and social resources.

Herzog & Wallace (1997) conducted the most complete study to date examining the quality of the HRS cognitive measures in the HRS samples. They provided results for simple internal consistency reliability (using α-indices), exploratory factor analysis (e.g., PC and Varimax rotation), and regression with demographic variables. Some of these findings show the limitations of the HRS cognitive battery, including lower than expected discriminations and reliabilities, and suggest a relatively complex 2-factor structure. Other findings show some of the cognitive tasks are clearly related to age, education and health.

Exploring the complex relationships among education, wealth, ethnicity and cognitive function, Cagney and colleagues (2002) used HRS data to show that while the positive association of education and cognitive function is only minimally weakened after adjusting for wealth, the positive association of higher levels of wealth on cognitive function is greatly attenuated after adjusting for education. The impact of education on cognitive function was different across various ethnic groups with Blacks and Whites exhibiting a similar and significant education-cognition relationship, while Latinos did not experience commensurate gains in cognitive function with increasing education. Results suggest that although the education-cognition relationship may in part reflect an SES gradient, the association is more likely due to the process and consequences of education itself.

Suthers and colleagues (2003) used the HRS to determine the national prevalence of moderate to severe cognitive impairment (CI) in older adults. They found that about 10% of individuals aged 70 or older were cognitively impaired, and that the average 70 year old can expect to live with CI for about 1.5 years. Women are likely to live a longer time with CI due to their longer life expectancy. Mehta and colleagues (2003) used the HRS to examine the impact of CI and depressive symptoms on mortality, finding that both CI and depressive symptoms were associated with increased two-year mortality in a progressive, additive manner.

Freedman and colleagues have used the HRS cognitive measures to examine trends in severe CI between 1993 and 1998, finding a significant reduction in severe impairment (from 6.1% to 3.6%) during this time period (Freedman et al., 2001). However, University of Michigan HRS researchers found that these improvements largely disappear, after adjusting for important features of the survey design (changes in age distribution of the sample across waves and prior exposure to the cognitive tests) and for changes in the demographic composition of the sample (race, ethnicity, gender; Rodgers et al., 2003). This work shows both the value of the HRS cognitive measures in examining the population prevalence of CI, as well as the complexities inherent in using longitudinal data for this purpose.

HRS data have been used to better understand the social, family, and economic impact of CI. For instance, Freund and Szinovacz (2002) found that CI was associated with driving restriction and cessation, although a noteworthy minority of mildly and severely impaired individuals continue to drive. A spouse's driving status, as well as the presence of other drivers in the household moderated the effect of cognition on the likelihood of driving restriction and cessation. The potential importance of driving cessation on the well-being of older adults was shown by Fonda and colleagues (2001), who found that respondents who stop driving are more likely to later report worsening depressive symptoms. Surprisingly, the effects of driving cessation on worsening depressive symptoms were not mitigated by the presence of a spouse who drives.

Using cognitive data from the 1993 AHEAD cohort of the HRS, Blaum and colleagues (2002) found that low cognitive performance (defined as $\leq$ 25th percentile on the AHEAD cognitive scale), regardless of its relationship to clinical dementia, coexists with multiple chronic diseases and conditions, and is independently associated with a broad array of functional difficulties, even after controlling for demographic characteristics, educational attainment, and chronic conditions.

The economic impact of CI has been studied across a number of dimensions using HRS data. Langa and colleagues estimated that US families provide approximately $18 billion per year in informal care for the disabilities related to CI in older individuals (Langa et al., 2001). In addition to this significant quantity of unpaid care, those with CI were found to incur significantly greater out-of-pocket medical expenditures; the adjusted mean annual out-of-pocket expenditure in 1995 was $1,350 for those without CI, $2,150 for those with mild/moderate impairment, and $3,010 for those with severe impairment (Langa, 2004). The doubling of out-of-pocket expenditures for those with severe CI was likely due to higher payments for both home-based and institutional long-term care. For example, in a separate study, Banaszak-Holl and colleagues (2004) used HRS data to determine that compared to older individuals with normal cognitive function, those with mild CI at baseline had about four times the odds of entering a nursing home during 7 years of follow-up, and those with moderate to severe CI had about 7 times the odds of entering a nursing home.

CI often leads to difficulty with the independent performance of activities of daily living (ADLs) and instrumental activities of daily living (IADLs; Langa 2001), which, in turn, is an important predictor of the utilization of paid home care services. Using 1993 and 1995 data, Langa and colleagues (2001) found that ADL and IADL disabilities were the most important predictor of paid home care services, and that the use of paid home care services became more strongly associated with the presence of co-resident children between 1993 and 1995. Freedman and colleagues (2004) have also used HRS data to examine trends in paid and unpaid home care; interestingly, they found that ADL and IADL disabilities were strongly associated with use of both paid and unpaid care, but the relationship was "asymmetric." While increases in the number of disabilities were accompanied by increases in care hours, decreases in disabilities, were not accompanied by similar magnitude decreases in care hours, especially with regard to paid home care. This finding is relevant to policy regarding publicly-paid home care services since it implies that, once in place, home care services may continue to be provided even after the resolution of an older individuals' limitations.

Finally, cognitive impairment at the end-of-life may have important implications for the adequacy with which common symptoms are recognized and treated by medical providers. Using data from the HRS "exit files," Silveira and colleagues (in press) found that 42% of those who died prior to the 1998 wave of the HRS had cognitive impairment (as assessed by a proxy respondent) and, among those with cognitive impairment, total symptom burden (including the presence of pain, depression, delirium, shortness of breath, fatigue, and loss of appetite) was significantly greater than those with normal cognition.

2.   *Additional Validation Opportunities with ADAMS: A Supplement to the HRS on Aging, Demographics and Memory Study*

Beginning in 2001, HRS investigators in collaboration with researchers at Duke University obtained supplemental funding for the Aging, Demographics, and Memory Study. The primary goal of the ADAMS study is to collect data that will allow researchers to estimate the prevalence of dementia in the U.S. elderly population. It will facilitate our understanding of the natural history of preclinical and clinical dementia as well as the role of dementia in changing the health and social function of older Americans. ADAMS will provide an opportunity for conducting in-depth investigations related to the impact of dementia on formal health care utilization, informal caregiving, and the total societal costs of this care. *A second aim of the study is to use data collected as part of the ADAMS study to examine the validity of the HRS cognitive functioning measures as a screening tool for cognitive impairment or dementia.*

A group of 1770 HRS respondents age 70 or older were selected from the 2000 and 2002 waves based on self- or proxy-cognition test performance. Among this group, we completed assessments with 856 respondents. Nurses and psychometric technicians traveled to respondents' homes to conduct in-depth clinical assessments. These include obtaining information on clinical and medical history, neuropsychological testing and collecting DNA samples to determine the apolipoprotein E (APOE) genotype. In some cases, medical records are obtained from the respondent's personal physician. Follow-up assessments are being conducted with approximately 30% of respondents to gather additional data to clarify the diagnosis. Each assessment is conducted with an informant (a family member, friend, or paid helper of the respondent) present. Information about caregiving and its costs and health services utilization is also collected.

An expert team of neurologists, psychiatrists, neuropsychologists, and internists review cases and assign diagnoses within one of three categories: demented (including possible and probable Alzheimer's Disease [AD], vascular dementia, etc.), cognitively impaired but not demented, and normal/non-case.

Each Duke assessment team consists of a clinical research nurse and psychometric technician, both specially trained in the evaluation of dementia. After obtaining consent, the psychometric technician administers the neuropsychological test battery to the respondent and the nurse meets separately with the informant to obtain detailed information about the respondent, including cognitive and functional changes, medical and psychiatric history, current medication use, and current behavioral and psychiatric symptoms. The nurse then meets with the respondent to conduct a brief global physical assessment, including measurements of blood pressure and heart rate, and height and weight as reported by the respondent. If the respondent is unable to provide this information, it is obtained from the informant. The nurse next performs a standardized neurological examination with the respondent and collects a buccal tissue sample

for DNA testing, while the psychometric technician meets with the informant to obtain information on the family history of memory impairment and also asks the informant to complete a dementia severity measure.

It is standard practice in tertiary AD specialty clinics to defer diagnosis in uncertain cases until longitudinal follow-up information is obtained; however, this is not an option in research protocols. Thus, for each respondent, a diagnosis will be assigned after the initial assessment. However, follow up assessments between 16-18 months after the initial assessment will be attempted for those with a diagnosis of 'cognitive impairment, not demented', mild dementia, or other syndromes for which longitudinal information will likely clarify the diagnosis. Respondents for whom a reassessment would be useful will be identified during the diagnostic conferences. The follow-up assessment protocol is primarily the same as the protocol at the initial assessment.

ADAMS fieldwork began in August, 2001 and will continue through March, 2005. Our projection is for data to be available for researchers by late 2005.

E.   Non-coverage and Non-response

The representative nature of a survey of the elderly is only achieved if every older person has a chance to be selected into the sample, and if every eligible sample member agrees to participate in the survey, or if those eligible persons who elect not to participate are a random subset of the total sample (Moser & Kalton, 1972). None of these conditions are met in the typical survey of the aged and there is evidence of bias in terms of cognition and health.

First, institutionalized persons are typically not included in the sampling frame for community surveys that consists of households only; this is a form of noncoverage error. Data from the National Nursing Home Survey suggest that 65% of nursing home residents have one or more cognitive disabilities, a rate which does not appear to differ much by age (Van Nostrand, Miller, & Furner, 1993). Data from the Minimum Data Set also suggest that as many as half of all nursing home residents are cognitively impaired (Morris, Fries, Mehr, Hawes, Phillips, Mor, & Lipsitz, 1994). In combination with the fact that 5% or more of the older population reside in nursing homes, this suggests that any rate of cognitive disability or impairment generated by a community survey would have to be increased by another couple percent to represent the many cognitively impaired living in institutions.

Second, although the HRS/AHEAD response rates are quite high (exceeding 80% at baseline), more typically survey response rates are around 70% or even lower and they tend to decrease with increasing age (Herzog & Rodgers, 1988), raising the possibility of nonresponse bias. This possibility is confirmed by the observation that nonrespondents tend to be in worse health and of lesser cognitive ability than respondents. Although it is typically difficult to learn much about those who did not participate in the survey, in the regional survey called Michigan Generations we made a special effort to collect such information from the interviewers and found that about one third of all older nonrespondents cited health reasons compared with less than 10% of young and middle-aged adults (Moles, 1987). Clearly, health problems are a much more prominent reason for non-participation among persons over 60 than among those who are younger. Note that in this study we could not distinguish between physical and cognitive health problems.

Finally, in the longitudinal HRS/AHEAD survey we can investigate how cognitive performance measured in the first wave predicts nonresponse status in the second wave (see Table 1 in Herzog & Rodgers, 1999). Those AHEAD Wave 1 respondents who became nonrespondents in Wave 2 performed less well cognitively in Wave 1 than those who remained respondents in Wave 2, suggesting that cognitive difficulties are a reason for subsequent nonresponse.

In the AHEAD survey we have taken steps to assess and possibly minimize the nonresponse bias. Thus, we are asking an informant (or proxy) respondent to participate if the eligible respondent is unable or unwilling to do so. For about one third of all such cases at Wave 1 we were able to interview an informant. These responses are included in the response rate calculation, raising it from about 70% to about 80%. Those represented by a proxy in Wave 2 performed worse in Wave 1 than self-respondents and even non-respondents (see Table 1 in Herzog & Rodgers, 1999), confirming the impression that proxy respondents often represent cognitively impaired respondents.

In order to learn more directly about the cognitive ability of those represented by a proxy, we attempted at AHEAD Wave 2 to collect cognitive performance information on those eligible respondents otherwise represented by a proxy. Out of some 900 such respondents about 100 were willing to try and about 60 completed the entire set of questions. This respondent information confirmed the hypothesis based on the proxy and the Wave 1 information: sample members for whom proxy interviews were obtained performed much worse on cognitive tasks such as free recall, Serial 7s and mental status-type tests than did self-respondents (see Table 2 in Herzog & Rodgers, 1999).

In addition, as noted in Section IV.D, 46% of AHEAD Wave 2 proxy respondents were identified as likely demented based on the Jorm IQCODE criterion. The percent with dementia is much lower in the general population in this age group, suggesting again that poor cognitive functioning is an important reason for a proxy response.

In general, then, nonrandom losses due to proxy response, nonresponse, and noncoverage suggest that the most cognitively impaired people are likely to be underrepresented in a typical survey. If proper representation of the population is at issue -- as it often is when one decides to use a survey -- this bias represents a shortcoming.

F.   Missing Data

Older respondents are also more likely than younger respondents to refuse or avoid answering a survey question. And again, this can lead to lower effective response rates for specific questions and to bias in the resulting data if the respondents who fail to provide an answer are different from those who do give an answer. In the AHEAD Wave 1 we faced this problem: About 10% refused to subtract 7s, 2% to 3% to memorize nouns for the free-recall test. These respondents scored significantly worse on the cognitive tests that they were willing to perform, i.e. the remaining mental status-type items and a self-rating of memory, than did those who completed these tasks (Herzog & Wallace, 1997). This implies that prevalence figures derived from a survey are further biased towards a cognitively well-functioning population by the missing answers from low functioning respondents. The level of item-missing data on the cognitive measures was much lower in later waves of AHEAD and in all waves of HRS. Overall missing data rates for word recall and Serial 7s are presented below in Table

Table 14				
Quantity of Missing Data on Immediate and Delayed Word Recall and Serial 7s				
	N	**Immediate Recall**	**Delayed Recall**	**Serial 7s**
Wave				
HRS 1992	12,004	2.0	2.8	N/A
AHEAD 1993	7,382	2.9	2.9	10.1
HRS 1994	10,691	3.7	5.3	N/A
AHEAD 1995	6,126	1.4	3.5	5.7
HRS 1996	10,225	0.6	0.8	2.8
HRS 1998	19,341	0.8	1.7	3.0
HRS 2000	17,518	1.0	1.6	3.1
HRS 2002	16,132	0.9	1.2	2.9

G.   Race/Ethnic Differences

Preliminary research of the HRS/AHEAD cognitive performance measures has revealed strong associations with race and ethnicity, with Caucasians performing markedly better than Hispanics and especially African Americans, controlling for a broad range of other factors (Ofstedal and Herzog, 1998). This pattern has also been found in previous research based on other data sources (Baker, Robinson, & Stewart, 1993; Fillenbaum et al., 1990; Gurland et al., 1992), and raises the concern over whether the race/ethnic differences are real or are merely measurement artifacts. Investigation into this issue has failed to reveal any obvious differences in measurement quality: (a) internal consistency reliability of the cognitive measures is similar across racial groups and where differences do exist internal consistency is higher for African-Americans and Hispanics compared to Whites (see Table 14 below), (b) factor analyses reveal a similar factor structure, and (c) the effects of the major correlates of cognitive functioning (e.g., age, education and other measures of SES, and health conditions) are consistent across groups (Ofstedal, Herzog and Fonda, in preparation).

Table 15			
Reliability coefficients for cognitive performance scales, by race and ethnicity: AHEAD 93			
Measure	**White**	**Black**	**Hispanic**
Total score (0-35)	0.76	0.81	0.79
Word recall score (0-20)	0.87	0.85	0.85
Mental status score (0-10)	0.67	0.75	0.70

H.   Test Equivalence

Word List Recall

Four different lists of 10 nouns for recall task; additional analyses needed to determine test equivalence across all 4 word lists. Additional analyses are planned using Item Response Theory to test for differences between lists.

Vocabulary

Two sets of 5 words each from the WAIS-R Vocabulary Test were used in HRS/AHEAD. Additional analyses are planned to test for item and test level equivalence between these two different versions of the vocabulary test.

VI.   Technical Documentation

A.   Cleaning Rules

Proxy cases were coded as missing (INAP) on all Section C cognitive performance tests.

Self-respondents were coded as missing (INAP) on all Section PC proxy cognition items.

(*For Serial 7's*): Wrong codes and typos that correspond with one of the following three scenarios were recoded as correct responses:

1. Case had a DOT=INAP code followed by correct answers;
2. Case has four correct codes and one code that is the transposition of a correct answer;
3. Case has four correct codes and one code that contains one of the single digits of a correct answer.

B.   Imputations

On a few of the cognitive measures there are small percentages of respondents who did not perform the individual tests of immediate and delayed free word recall and Serial 7s. Specifically, the amount of missing data ranged from 0.8% to 5.7% on these measures across all waves of HRS and AHEAD through 2002 (see Table X). Imputations of these missing values are important for two reasons. First, by examining performance among these respondents on the non-missing items, it is clear that the data are not missing at random; respondents with cognitive difficulties on some items are more likely to have missing data on others (Herzog and Wallace, 1997; Herzog and Rodgers, 1999; Stewart, Zelinski, Crimmins, & Seeman, 1998). Therefore, excluding respondents with some missing answers would produce a biased sample and imputation of the missing responses is an approach to minimize this potential bias. Secondly, imputation of the missing values facilitates the development of constructed summary variables that can be utilized as indicators of a more general cognition measure among all participants. We have developed a multiple imputation strategy that utilizes the non-missing cognitive scores across waves and a few covariates that are strongly

related to cognitive performance (e.g., age and education; c.f., Rodgers; Ofstedal, & Herzog, 2003).

Work is currently underway to produce imputations of cognitive variables for all waves through the 2002 wave. The imputation approach for each wave utilizes data from waves before and after the target wave. Thus, early release data from the 2004 wave (expected May, 2005) will be used to produce 2002 imputations, and the cognition imputations will be released approximately two months later (summer 2005). This schedule will then be repeated in future waves (final 2004 imputations will be released in mid-2007 following the early release of 2006 data, and so on). An early release version of imputations for the current wave will also be made available using only past and current wave data in the imputations.

C.   Unimputed Constructed Variables

1.   Description of Variables (unimputed method)

Syntax to guide users in the creation of constructed variables for HRS92 through 02 and AHD 93 and 95 is included in the appendix of this report. Users who prefer SPSS, Stata, or some other statistical package will want to provide equivalent statements and can use the syntax provided as a guide. A description of these variables follows on the next page.

Immediate recall

Count of number of words that were recalled correctly (immrec92, etc.). Count ranges from 0 to 10 in all waves except HRS 92 & HRS 94, in which the count ranges from 0 to 20. Respondents who tried, but were unable to recall any words were assigned 0. Respondents who refused to participate in the task before recalling any words were assigned missing values.

Delayed recall

Count of number of words that were recalled correctly (delrec92 etc.). Count ranges from 0 to 10 in all waves except HRS 92 & HRS 94, in which the count ranges from 0 to 20. Respondents who tried, but were unable to recall any words were assigned 0. Respondents who refused to participate in either the immediate or delayed recall task were assigned missing values.

Total Recall

Count of the number of words recalled in both the immediate and delayed word recall tasks (totrec92, etc.). This was computed by taking the sum of the immediate recall and delayed recall variables.

Date Naming

Dichotomous variables for each of the four individual items of month, day, year, and day of week (mo93, dy93, yr93, dw93, etc.). The variables were coded 1 if respondent provided the correct answer, 0 if incorrect or "don't know." Respondents who refused to answer any given item were assigned a missing value. These variables were constructed

for all waves except HRS 92 & 94, as the date naming items were not added to the survey until AHEAD 93 & HRS 96.

In addition, these four dichotomous variables for each date item were summed to create a count of correct responses (dates93). Count ranges from 0 to 4.

Backwards Count

All waves except HRS 92 & 94 included a backwards count exercise, which required respondents to count backwards from 20 for 10 continuous numbers. HRS 96 & 98, and AHEAD 95 included two backwards count exercises for better reliability, the first counting from 20 and the second counting from 86. Respondents were allowed two trials for each exercise.

The following three-category variable was constructed for each backwards count (bwc20_96, bwc86_96, etc.)

> 0 - incorrect or "don't know/unable to do" on both tries
> 1 - incorrect on first try, but correct on second try
> 2 - correct on first try

Respondents who refused to attempt either trial were assigned missing values.

Serial 7's test

Respondents were asked to subtract by 7 a total of five times, starting from 100. The constructed variable for this task (ser7_96) is a count of the number of correct subtractions that were made, ranging from 0 to 5. Each subtraction was scored independently; for example, if a respondent made a mistake on the first subtraction (e.g., reported 92 rather than 93), but gave correct answers for each subsequent subtraction (using 92 as starting point and answering with 85 for the second subtraction), he/she would have received a score of 4 on the constructed variable.

Respondents who refused to perform the test at the outset or who began the test and refused mid-way through were assigned missing values.

Summary Scores

TICS
TICS score (TICS96, etc.). Variable that counts number of correct responses to all of the TICS items. Values range from 0 to 10.

Total Cognition
Total cognitive score (totcog96, etc.) Variable that counts the number of correct responses to all of the cognitive measures that were common across waves. Values range from 0 to 35.

Vocabulary (AHEAD 95 and HRS 96)

Beginning in AHEAD 95, respondents were presented with a set of 5 vocabulary words and were asked to provide the definition for each in turn. The interviewer recorded verbatim definitions that were subsequently coded according to instructions for the WAIS-R to indicate degree of correctness.

LIST #1   **LIST #2**

Repair   Conceal
Fabric   Enormous
Domestic   Perimeter
Remorse   Compassion
Plagiarize   Audacious

Responses to vocabulary word items were coded as follows:
    2. Answer perfectly correct
    1. Answer partially correct
    0. DK; answer incorrect
    9. Refused; no answer

Respondents were assigned missing values on variables corresponding to each of the words they *did not* receive. Respondents who reported "don't know" were assigned a value of 0. Respondents who refused this task were assigned missing values.

Similarities

Count of individual similarity item scores across all of the items administered at any particular wave (which was 7 items in HRS 92 & 94, and 6 items in AHEAD 93). Count ranges from 0 to 14 in HRS 92 and 94, and from 0 to 12 in AHEAD 93. Each item was coded according to instruction in the WAIS-R manual as follows:

    2. Answer perfectly correct
    1. Answer partially correct
    0. DK; answer incorrect
    9. Refused; no answer

"Don't Know" responses were coded as 0 (incorrect). Respondents were coded as missing if they refused the task at the outset or did not attempt at least any one of the individual items. The large number of missing values on this variable is due to administration of this test to only a subset of respondents as part of a module in the survey design.

VII. References

Ashford, J.W., Kolm, P., Colliver, J.A., Bekian, C., & Hsu, L. (1989). Alzheimer patient evaluation and the Mini-Mental State: Item characteristic curve analysis. *Journal of Gerontology: Psychological Sciences*, 44, P139-P146.

Baker, F.R., Robinson, B.H., & Stewart, B. (1993). Use of the Mini-Mental State Examination in African-American Elders. In T.L. Brink (Ed.), *The forgotten aged: Ethnic, psychiatric, and societal minorities* (pp. 5-13). New York: Hayworth Press.

Banaszak-Holl, J., Fendrick, A. M., Foster, N., Herzog, A. R., Kabeto, M., Kent, D., Straus, W., and Langa, K. M. (2004). Predicting Nursing Home Admission: Estimates from a seven-year follow-up of a nationally representative sample of older Americans. Alzheimer Disease and Associated Disorders, 18(2), 83-89.

Blaum, C. S., Ofstedal, M. B., and Liang, J. (2002). The relationship of low cognitive performance to task specific disability: Findings from a population-based survey Journals of Gerontology: Medical Sciences, 57, M523-M531.

Brandt, J., Spencer, M. and Folstein, M. (1988). The Telephone Interview for Cognitive Status. *Neuropsychiatry, Neuopsychology, and Behavioral Neurology*, 1:111-117.

Breitner, J. C. S., Welsh, K. A., Gau, B. A., McDonald, W. M., Steffens, D.C., Saunders, A.M., Magruder, K.M., Helms, M. J., Plassman, B.L., Folstein, M.F., Brandt, J., Robinette, C. D., Page, W. F. (1995). Alzheimer's disease in the National Academy of Sciences-National Research Council Registry of aging twin veterans. III: Detection of cases, longitudinal results, and observations on twin concordance. *Archives of Neurology,* 52, 763-771.

Cagney, K.A. and D.S. Lauderdale. (2002). Education, wealth and cognitive function in later life. *Journal of Gerontology: Psychological Sciences* 57B:P163-P172.

Christensen, H., Mackinnon, A., Jorm, A.F., Henderson, A.S., Scott, L.R., & Korten, A.E. (1994). Age differences and interindividual variation in cognition in community-dwelling elderly. *Psychology and Aging,* 9, 381-390.

Colsher, P.L., & Wallace, R.B. (1991). Longitudinal application of cognitive function measures in a defined population of community-dwelling elders. *Annals of Epidemiology*, 1, 215-230.

Cook, T.D., & Campbell, D.T. (1979). *Quasi-experimentation: Design and analysis issues for field settings*. Chicago: Rand McNally.

Cortina, J.M. (1993). What is coefficient alpha? An examination of theory and applications. *Journal of Applied Psychology, 78,* 98-104.

Craik, F.I.M. (1999). Memory, aging, and survey measurement. In N. Schwarz, D.C. Park, B. Knauper, & S. Sudman (Eds.), *Cognition, aging, and self-reports*. Philadelphia: Psychology Press.

Dixon, R.A. (1989). Questionnaire research on metamemory and aging: Issues of structure and function. In L. Poon, D. Rubin, and B. Wilson (Eds.), *Everyday cognition in adulthood and late life.* Cambridge, MA: Cambridge University Press.

Dixon, R.A., Hertzog, C., & Hultsch, D. (1986). The multiple relationships among metamemory in adulthood (MIA) scales and cognitive abilities in adulthood. *Human Learning, 5,* 165-177.

Fillenbaum, G.G., Hughes, G., Heyman, A., George, L.K., & Blazer, D.G. (1988). Relationship of Health and Demographic Characteristics to Mini-Mental State Examination Score among Community Residents. *Psychological Medicine*, 18, 719-726.

Fillenbaum, G.G., Heyman, A., Williams, K., Prosnitz, B., & Burchett, B. (1990). Sensitivity and specificity of standardized screens of cognitive impairment and dementia among elderly Black and White community residents. *Journal of Clinical Epidemiology*, 43:651-660.

Folstein, M.F., Folstein, S.E., & McHugh, P.R. (1975). Mini-Mental State: A practical method for grading the cognitive state of patients for the clinician. *Journal of Psychiatric Research*, 12, 189-198.

Fonda, S. J., Wallace, R. B., and Herzog, A. R. (2001). Changes in driving patterns and worsening depressive symptoms among the elderly. *Journals of Gerontology: Social Sciences, vol. 56B*, pp. S343-S351.

Freedman, V. A., Aykan, H., & Martin, L. G. (2001). Aggregate changes in severe cognitive impairment among older Americans: 1993 and 1998. *Journals of Gerontology: Social Sciences, 56B*, 100-111.

Freund, B. and Szinovacz, M., (2002). Effects of cognition on driving involvement among the oldest old: Variations by gender and alternative transportation opportunities. *The Gerontologist, 42*, 621-633.

Groves, R.M., & Kahn, R.L. (1979). *Surveys by telephone*. New York: Academic Press.

Gurland, B.J., Wilder, D.E., Cross, P., Teresi, J., & Barrett, V.W. (1992). Screening scales for dementia: Toward reconciliation of conflicting cross-cultural findings. *International Journal of Geriatric Psychiatry*, 7, 105-113.

Herzog, A.R., & Rodgers, W.L. (1988). Age and response rates to interview sample surveys. *Journal of Gerontology: Social Sciences*, 43, S200-S205.

Herzog, A.R., & Rodgers, W.L. (1999). Cognitive performance measures in survey research on older adults. In N. Schwarz, D.C. Park, B. Knauper, & S. Sudman (Eds.), *Cognition, aging, and self-reports*. Philadelphia: Psychology Press.

Herzog, A.R., & Wallace, R.B. (1997). Measures of Cognitive Functioning in the AHEAD Study. *Journals of Gerontology Series B*, 52B(Special Issue): 37-48.

Horn, J. (1987). A context for understanding information processing studies of human abilities. In P.E. Vernon (Ed.), *Age-related changes in intelligence and speed of information processing* (pp. 201-238). Norwood, NJ: Ablex.

Hultsch, D.F., Hertzog, C., Small, B.J., McDonald-Miszczak, L., & Dixon, R.A. (1992). Short-term longitudinal change in cognitive performance in later life. *Psychology and Aging*, 7, 571-584.

Jorm, A.F. 1994. A short form of the Informant Questionnaire on Cognitive Decline in the Elderly (IQCODE): Development and cross-validation. *Psychological Medicine*, 24: 145-153.

Jorm, A.F., & Jacomb, P.A. (1989). The Information Questionnaire on Cognitive Decline in the Elderly (IQCODE): Sociodemographic correlates, reliability, validity and some norms. *Psychological Medicine*, 19, 1015-1022.

Langa, K. M., Chernew, M. E., Kabeto, M. U., Herzog, A. R., Ofstedal, M. B., Willis, R. J., Wallace, R. B., Mucha, L. M., Straus, W. L., and Fendrick, A. M. (2001). National estimates of the quantity and cost of informal caregiving for the elderly with dementia. *Journal of General Internal Medicine, 16*, 770-778.

Langa, K. M., Larson, E. B., Wallace, R. B., Fendrick, A. M., Foster, N. L., Kabeto, M. U., Weir, D. R., Willis, R. J., & Herzog, A. R. (2004). Out-of-pocket health care expenditures among older Americans with dementia, Alzheimer Disease and associated disorders, 18, 90-98.

Lindenberger, U., Mayr, U., & Kliegl, R. (1993). Speed and intelligence in old age. *Psychology and Aging*, 8, 207-220.

Masur, D.M., Sliwinski, M., Lipton, R.B., Blau, A.D., & Crystal, H.A. (1994). Neuropsychological prediction of dementia and the absence of dementia in healthy elderly persons. *Neurology*, 44, 427-1432.

Moles, E.L. (1987, November). Perceptions of the interview process. Paper presented as part of the symposium "Interviewing Older Adults", presented at the 40th Annual Scientific Meeting of Gerontological Society of America, Washington, DC.

Morris, J.N., Fries, B.E., Mehr, D.R., Hawes, C., Phillips, C., Mor, V., & Lipsitz, L.A. (1994). MDS cognitive performance scale. *Journal of Gerontology: Medical Sciences*, 49(4), M174-M182.

Moser, C.A., & Kalton, G. (1972). *Survey methods in social investigations* (2nd ed.). New York: Basic Books.

Nesselroade, J.R., Pedersen, N.L., McClearn, G.E., Plomin, R., & Bergeman, C.S. (1988). Factorial and criterion validates of telephone-assessed cognitive ability measures. *Research on Aging*, 10, 220-234.

Ofstedal, M.B., & Herzog, A.R. (1998). Factors Associated with Change in Cognitive Functioning among the Oldest-Old. Paper session at Gerontological Society of America Annual Meeting, Philadelphia, PA.

Ofstedal, M.B., Herzog, A.R., & Fonda, S. (In preparation). An investigation of race and ethnic differences in cognitive performance in the HRS and AHEAD. *Health and Retirement Study Working Paper Series*. Ann Arbor, MI: Institute for Social Research, University of Michigan.

Paivio, A., Yuille, J.C., & Madigan, S.A. (1968). Concreteness, imagery, and meaningfulness values for 925 nouns. *Journal of Experimental Psychology*, 76, 1-25.

Park, D. (1995). Personal communication.

Park, D. (1999). Cognitive aging, processing resources, and self-report. In N. Schwarz, D.C. Park, B. Knauper, & S. Sudman (Eds.), *Cognition, aging, and self-reports*. Philadelphia: Psychology Press.

Perlmutter, M. (1988). Cognitive potential throughout life. In J.E. Birren & V. Bengtson (Eds.), *Emergent theories of aging* (pp. 247-268). New York: Springer.

Pfeiffer, E. (1975). A short portable mental status questionnaire for the assessment of organic brain deficit in elderly patients. *Journal of the American Geriatrics Society*, 22, 433-444.

Poon, L.W. (1985). Differences in human memory with aging: Nature, causes, and clinical implications. In J.E. Birren & K.W. Schaie (Eds.), *Handbook of the psychology of aging* (2nd ed., pp. 427-462). New York: Van Nostrand Reinhold.

Reed, B.R., Jagust, W.J., & Seab, J.P. (1989). Mental status as a predictor of daily function in progressive dementia. *The Gerontologist*, 29, 804-807.

Rodgers, W. L., Ofstedal, M. B., and Herzog, A. R. (2003). Trends in scores on tests of cognitive ability in the elderly U.S. population, 1993-2000. *The Journals of Gerontology, Series B: Social Sciences, 58B*, S338-S3462003.

Roth, M., Tym, E., Mountjoy, C.Q., Huppert, F.A., Hendrie, H., Verma, S., & Goddard, R. (1986). CAMDEX: A standardized instrument for the diagnosis of mental disorder in the elderly with special reference to the early detection of dementia. *British Journal of Psychiatry*, 149, 698-709.

Rubin, D.C., & Friendly, M. (1986). Predicting which words get recalled: Measures of free recall, availability, goodness, emotionality, and pronunciability for 925 nouns. *Memory and Cognition*, 14(1), 79-94.

Salthouse, T.A. (1985). Speed of behavior and its implications for cognition. In J.E. Birren & K.W. Schaie (Eds.), *Handbook of the psychology of aging* (2nd ed., pp. 427-462). New York: Van Nostrand Reinhold.

Salthouse, T.A. (1996). The processing-speed theory of adult age differences in cognition. *Psychological Review, 103,* 403-428.

Salthouse, T.A. (1999). Pressing issues in cognitive aging. In N. Schwarz, D.C. Park, B. Knauper, & S. Sudman (Eds.), *Cognition, aging, and self-reports*. Philadelphia: Psychology Press.

Schaie, K.W., & Hertzog, C. (1983). Fourteen-year cohort-sequential analysis of adult intellectual development. *Developmental Psychology*, 19, 531-543.

Stewart, S., Zelinski, L., Crimmins, E. and Seeman, T. (1998) "Measuring Cognitive Ability in Large, National Survey Samples: The Implications of Decisions Regarding Missing Data." Presented at the Annual Meetings of the Gerontological Society of America, Philadelphia; November 1998.

Suthers, K., Kim, J. K., and Crimmins, E. (2003). Life expectancy with cognitive impairment in the older population of the United States. *Journals of Gerontology, Social Sciences, 58*, S179-S186.

Thorndike, E.L., & Lorge, I. (1944). *The teacher's word book of 30,000 words*. New York: Teacher's College.

VanNostrand, J.F., Miller, B., & Furner, S.E. (1993). Selected issues in long-term care: Profile of cognitive disability of nursing home residents and the use of informal and formal care by elderly in the community. *Vital and health statistics. Health data on older Americans: United States, 1992. Series 3: Analytic and epidemiological studies, No. 27*. Hyattsville, MD: U.S. Department of Health and Human Services, National Center for Health Statistics.

Weiler, P.G., Chiriboga, D.A., & Black, S.A. (1994). Comparison of mental status tests: Implications for Alzheimer's patients and their caregivers. *Journal of Gerontology: Social Sciences*, 49, S44-S51.

Welsh, K.A., Butters, N., Hughes, J.P., Mohs, R.C., & Hayman, A. (1992). Detection and staging of dementia in Alzheimer's disease. Use of the neuropsychological measures developed for the Consortium to Establish a Registry for Alzheimer's Disease. *Archives of Neurology*, 49, 448-452.

Wray, L.A., Herzog, A.R., & Park, D.C. (1996, November). Physical health, mental health, and function among older adults. Paper session at Gerontological Society of America Annual Meeting, Washington, DC.

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

Question	HRS 92	HRS 94	HRS 96	AHEAD 93	AHEAD 95	HRS 98	HRS 00	HRS 02
Self-rated memory	L1	C1	C1	C1	C1, M10-1	C1	C1	HD101
Memory compared to 2 years ago/last interview	L2	C2	C2	C2	C2, M10-2	C2	C2	HD102
Immediate word recall	L4 (20)	C3-4 (20)	C3-4 (10)	C3 (10)	C3-4, M10-3	C3 (10)	C3-4 (10)	HD182M1-HD182M9
Delayed word recall	L17	C19	C12	C12	C12, M10-12	C12	C8	HD183M1-HD183M9
Date (mo/day/yr)	-	-	C5a	C5a-c	C5a, M10-5	C9a-c (65+)	C9a-c	HD151-HD153
Day of week	-	-	C5a	C5d	C5a, M10-5	C9d (65+)	C9d	HD154
Backwards count (20)	-	-	C6		C6, M10-6	C6	C6	HD124, HD129
Backwards count (86)	-	-	C6a		C6a, M10-6a	C6	-	HD134, HD139
Word recognition								
Scissors	-	-	C7		C7, M10-7	C10 (65+)	C10	HD155
Cactus	-	-	C8		C8, M10-8	C11 (65+)	C11	HD156
President	-	-	C9		C9, M10-9	C12 (65+)	C12	HD157
Vice-president	-	-	C10		C10, M10-10	C12a (65+)	C12a	HD158
Serial 7's	-	-	C11a-e		C11, M10-11	C7a-e	C7a-e	HD142-HD146
Vocabulary	-	-	-		C13, M10	C13a-j (65+)	C13	HD161-HD169
Similarities items	L5a-g		M5-2, M53a-e		-	-	-	-
Memory-related disease	-				-	B10d	B10d	HD069
Numeracy (core)								HD178-HD180
Numeracy Module								HV350-HV368

Table 2. Cognition Questions Asked in HRS and AHEAD: Proxy Respondents

Question	HRS 92	HRS 94	HRS 96	AHEAD 93	AHEAD 95	HRS 98	HRS 00	HRS 02
Memory-related disease						B10d	B10d	C069
Memory rating			PC1	PC1	PC1	PC1 (all)	PC1	D501
Change in memory in past 2 years (better/worse)				PC2		PC2 (<65)	PC2 (<65)	D502
Judgments/ decisions rating			PC3	PC3	PC3	PC3 (65+)	PC3	D503
Judgments/ decisions change								
Organize daily activities rating			PC5	PC5	PC5	PC5 (65+)	PC5	D504
Organize daily activities change								
Lost in familiar environment			PC24	PC7a	PC24	PC24 (65+)	PC24	D554
Wander off			PC25	PC7b	PC25	PC25 (65+)	PC25	D555
Left alone			PC26	PC7c	PC26	PC26 (65+)	PC26	D556
Hear things not there			PC27	PC7d	PC27	PC27 (65+)	PC27	D557
Angry/hostile			PC28	PC8a	PC28	PC28 (65+)	PC28	D558
Difficulty falling asleep			PC29	PC8b	PC29	PC29 (65+)	PC29	D559
Dangerous behavior			PC30	PC8c	PC30	PC30 (65+)	PC30	D560
Pacing/rocking			PC31	PC8d	PC31	PC31 (65+)	PC31	D561
Thinks people plotting/harming			PC32	PC8e	PC32	PC32 (65+)	PC32	D562
Excessive alcohol consumption			PC33	PC8f	PC33	PC33 (65+)	PC33	D563

Note: New respondents are asked all proxy cognition questions, regardless of age.

Table 2. (cont.)

Question	HRS 92	HRS 94	HRS 96	AHEAD 93	AHEAD 95	HRS 98	HRS 00	HRS 02
Change in ability to:								
Remember things about family/friends			PC8		PC8	PC8 (65+)	PC8	D506
Remember recent things			PC9		PC9	PC9 (65+)	PC9	D509
Recall conversations			PC10		PC10	PC10 (65+)	PC10	D512
Remember address/phone			PC11		PC11	PC11 (65+)	PC11	D515
Remember day/month			PC12		PC12	PC12 (65+)	PC12	D518
Remember where things kept			PC13		PC13	PC13 (65+)	PC13	D521
Remember where to find things			PC14		PC14	PC14 (65+)	PC14	D524
Know how to work familiar machines			PC15		PC15	PC15 (65+)	PC15	D527
Learn to use new gadgets/machines			PC16		PC16	PC16 (65+)	PC16	D530
Learn new things in general			PC17		PC17	PC17 (65+)	PC17	D533
Follow a story in book/on TV			PC18		PC18	PC18 (65+)	PC18	D536
Make decisions on everyday matters			PC19		PC19	PC19 (65+)	PC19	D539
Handle money for shopping			PC20		PC20	PC20 (65+)	PC20	D542
Handle financial matters			PC21		PC21	PC21 (65+)	PC21	D545
Handle everyday arithmetic problems			PC22		PC22	PC22 (65+)	PC22	D548
Understand/reason			PC23		PC23	PC23 (65+)	PC23	D551

Note: New respondents are asked all proxy cognition questions, regardless of age.

Table 3. Variable names for cognition questions asked in HRS and AHEAD: Self-respondents

Question	HRS 92	HRS 94	HRS 96	AHEAD 93	AHEAD 95	HRS 98	HRS 00	HRS 02
Self-rated memory1	V5101	W5810	E1161	V355	D1161	F1479	G1654	HD101
Memory compared to one year ago / last interview	V5102	W5811	E1162	V356	D1162	F1480	G1655	HD102
Immediate word recall	V5105	W5832	E1174M1-E1174M11	IMMWORDC	D1174M1-D1174M11	F1491M1-F1491M11	G1666M1-G1666M11	HD182M1-HD182M9
Date (month / day / year)	-	-	E1179-E1181	V373-V375	D1179-D1182	F1645-F1648	G1820-G1823	HD151-HD153
Day of week	-	-	E1182	V376				HD154
Backwards count (20)	-	-	E1205, E1228	V379	D1205, D1228	F1535, F1558	G1710, G1733	HD124, HD129
Backwards count (86)	-	-	E1264, E1287	-	D1264, D1287	F1594, F1617	G1769, G1792	HD134, HD139
Word recognition								
Scissors	-	-	E1301	V380	D1301	F1649	G1824	HD155
Cactus	-	-	E1302	V381	D1302	F1650	G1825	HD156
President	-	-	E1303	V382	D1303	F1651	G1826	HD157
Vice-president	-	-	E1304	V383	D1304	F1652	G1827	HD158
Serial 7's	-	-	E1305-E1309	V384-V388 Series7	D1305-D1309	F1631-F1635	G1806-G1810	HD142-HD146
Delayed word recall	V5126	W5877	E1314M1-E1314M11	V393A1-V393A11 DELWORDC	D1314M1-D1314M11	F1640M1-F1640M11	G1815M1-G1815M11	HD183M1-HD183M9
Vocabulary								
Repair/conceal	-	-	E1320_1 / E1320_2	-	D1320_1 / D1320_2	F1657_1/F1657_2	G1832_1/G1832_2	HD161
Fabric/enormous	-	-	E1323_1 / E1323_2	-	D1323_1 / D1323_2	F1660_1/F1660_2	G1835_1/G1835_2	HD163
Domestic/perimeter	-	-	E1326_1 / E1326_2	-	D1326_1 / D1326_2	F1663_1/F1663_2	G1838_1/G1838_2	HD165
Remorse/compassion	-	-	E1329_1 / E1329_2	-	D1329_1 / D1329_2	F1666_1/F1666_2	G1841_1/G1841_2	HD167
Plagiarize/audacious	-	-	E1332_1 / E1332_2	-	D1332_1 / D1332_2	F1669_1/F1669_2	G1844_1/G1844_2	HD169
WAIS similarity test	V5106-V5112 V5113*	W9270-W9276	-	V2110A1-V2110A6	-	-	-	

Table 3. Variable names for cognition questions asked in HRS and AHEAD: Proxy-respondents

Question	HRS 92	HRS 94	HRS 96	AHEAD 93	AHEAD 95	HRS 98	HRS 00	HRS 02
Memory rating	-	-	E1056	V323	D1056	F1373	G1527	HD501
Change in memory in past 2 years (better / worse)	-	-	-	V324-V327	-	F1374	G1528	HD502
Judgements / decisions rating	-	-	E1061	V328	D1061	F1378	G1532	HD503
Judgements / decisions change	-	-	-	V329-V332	-	-	-	-
Organize daily activities rating	-	-	E1066	V333	D1066	F1383	G1537	HD504
Organize daily activities change	-	-	-	V334-V337	-	-	-	-
Lost in familiar environment	-	-	E1144	V342	D1144	F1461	G1615	HD554
Wander off	-	-	E1145	V343	D1145	F1462	G1616	HD555
Left alone	-	-	E1146	V344	D1146	F1463	G1617	HD556
Hear things not there	-	-	E1147	V345	D1147	F1464	G1618	HD557
Angry / hostile	-	-	E1148	V346	D1148	F1465	G1619	HD558
Difficulty falling asleep	-	-	E1149	V347	D1149	F1466	G1620	HD559
Dangerous behavior	-	-	E1150	V348	D1150	F1467	G1621	HD560
Pacing / rocking	-	-	E1151	V349	D1151	F1468	G1622	HD561
Thinks people plotting / harming	-	-	E1152	V350	D1152	F1469	G1623	HD562
Excessive alcohol consumption	-	-	E1153	V351	D1153	F1470	G1624	HD563
Cognition module administered to subjects with proxy respondents	-	-	MODULE10	-	MODULE10	MODULE 10	-	

Table 3. (cont.)

Question	HRS 92	HRS 94	HRS 96	AHEAD 93	AHEAD 95	HRS 98	HRS 00	HRS 02
<u>Change in ability to:</u>								
Remember things about family / friends	-	-	E1072-E1074	-	D1072-D1074	F1389-F1391	G1543-G1545	HD506-HD508
Remember recent things	-	-	E1077-E1079	-	D1077-D1079	F1394-F1396	G1548-G1550	HD509-HD5111
Recall conversations	-	-	E1082-E1084	-	D1082-D1084	F1399-F1401	G1553-G1555	HD512-HD514
Remember address / phone	-	-	E1087-E1089	-	D1087-D1089	F1404-F1406	G1558-G1560	HD515-HD517
Remember day / month	-	-	E1092-E1094	-	D1092-D1094	F1409-F1411	G1563-G1565	HD518-HD520
Remember where things are kept	-	-	E1097-E1099	-	D1097-D1099	F1414-F1416	G1568-G1570	HD521-HD523
Remember where to find things	-	-	E1102-E1104	-	D1102-D1104	F1419-F1421	G1573-G1575	HD524-HD526
Know how to work familiar machines	-	-	E1107-E1109	-	D1107-D1109	F1424-F1426	G1578-G1580	HD527-HD529
Learn to use new gadgets / machines	-	-	E1112-E1114	-	D1112-D1114	F1429-F1431	G1583-G1585	HD530-HD532
Learn new things in general	-	-	E1117-E1119	-	D1117-D1119	F1434-F1436	G1588-G1590	HD533-HD535
Follow a story in book / on TV	-	-	E1122-E1124	-	D1122-D1124	F1439-F1441	G1593-G1595	HD536-HD538
Make decisions on everyday matters	-	-	E1127-E1129	-	D1127-D1129	F1444-F1446	G1598-G1600	HD539-HD541
Handle money for shopping	-	-	E1132-E1134	-	D1132-D1134	F1448-F1450	G1602-G1604	HD542-HD544
Handle financial matters	-	-	E1135-E1137	-	D1135-D1137	F1451-F1453	G1605-G1607	HD545-HD547
Handle everyday arithmetic problems	-	-	E1138-E1140	-	D1138-D1140	F1454-F1456	G1608-G1610	HD548-HD550
Understand / reason	-	-	E1141-E1143	-	D1141-D1143	F1457-F1459	G1611-G1613	HD551-HD553

Table 5. Frequency distributions* for cognition measures in HRS and AHEAD: Age-eligible self-respondents

Question Sample Size (Age-eligible self-respondents)	HRS 92 N=9298	HRS 94 N=8306	HRS 96 N=7948	AHEAD 93 N=6656	AHEAD 95 N=5443	HRS 98 N=18438	HRS 00 N=16614	HRS 02 N=15205
Self-rated memory1								
Excellent	1816	1335	514	616	417	1414	984	755
Very good	3328	2687	1762	1697	1202	4525	3972	3718
Good	2689	2732	3468	2639	2211	7974	7353	6654
Fair	1139	1218	1794	1379	1273	3744	3574	3385
Poor	272	308	401	318	334	762	709	677
Missing	54	26	9	7	6	19	22	16
Memory compared to one year ago / last interview								
Better	811	527	233	202	153	502	382	274
Worse	1165	1037	1409	873	1132	3476	2954	11816
No change	7272	6716	6295	5576	4151	14434	13244	3088
Missing	50	26	11	5	7	26	34	27
Difficulty remembering clearly2								
Strongly agree	666	-	-	-	-	-	-	-
Agree	4794	-	-	-	-	-	-	-
Disagree	3253	-	-	-	-	-	-	-
Strongly disagree	505	-	-	-	-	-	-	-
Missing	80	-	-	-	-	-	-	-
Month								
Correct	-	-	7790	6308	5227	11466	9124	9200
Incorrect	-	-	153	321	203	332	284	345
Missing	-	-	5	27	13	6640	7206	5660
Day								
Correct	-	-	6779	5200	4314	9724	7726	7967
Incorrect	-	-	1165	1432	1124	2082	1692	1578
Missing	-	-	4	24	5	6632	7196	5660
Year								
Correct	-	-	7850	6285	5173	11388	9192	9124
Incorrect	-	-	94	352	264	416	223	421
Missing	-	-	4	19	6	6634	7199	5660
Day of week								
Correct	-	-	7845	6360	5200	11438	9416	9118
Incorrect	-	-	99	280	238	367	304	427
Missing	-	-	4	16	5	6633	7198	5660

Note: In HRS 98 & later, Date Naming was only asked of R's age 65+ or new interviews
*Unweighted

Table 5. (cont)

Question	HRS 92	HRS 94	HRS 96 N=7948	AHEAD 93 N=6656	AHEAD 95 N=5443	HRS 98 N=18438	HRS 00	HRS 02
Scissors								
Correct	-	-	7855	6551	5347	11682	9402	9442
Incorrect	-	-	81	75	78	116	77	104
Missing	-	-	12	30	18	6640	7212	5659
Cactus								
Correct	-	-	7268	5454	4587	10633	9401	8629
Incorrect	-	-	670	1135	839	1163	935	915
Missing	-	-	10	67	17	6642	7213	5661
President								
Correct	-	-	7539	5968	4943	11285	8915	9143
Incorrect	-	-	399	643	485	512	485	403
Missing	-	-	10	45	15	6641	7214	5659
Vice-president								
Correct	-	-	5836	4696	3602	9904	8474	6570
Incorrect	-	-	2101	1859	1826	1892	927	2973
Missing	-	-	11	101	15	6642	7213	5662
Backwards count1 (20)								
0 - incorrect on both tries	-	-	265	496	277	829	742	655
1 - correct on 2nd try only	-	-	7	246	7	18	44	14
2 - correct on first try	-	-	7613	5759	4993	17454	15680	14414
Missing	-	-	63	155	166	137	148	122
Backwards count (86)								
0 - incorrect on both tries	-	-	874	-	824	2492	2254	1956
1 - correct on 2nd try only	-	-	7	-	6	35	48	17
2 - correct on first try	-	-	6948	-	4368	15715	14128	13085
Missing	-	-	119	-	245	196	184	147

Note: In HRS 98 & later, Word Recognition and Pres./VP was only asked of R's age 65+ or new interviews

Table 6. Percentage distributions* for cognition measures in HRS and AHEAD: Age-eligible self-respondents

Question	HRS 92	HRS 94	HRS 96	AHEAD 93	AHEAD 95	HRS 98	HRS 00	HRS 02
Self-rated memory 1								
Excellent		17.0	6.6	9.3	7.4	9.2	7.0	5.4
Very good		34.2	23.1	25.9	22.3	26.5	25.8	26.1
Good		32.7	44.2	40.3	41.4	42.7	44.1	43.9
Fair		13.0	21.6	20.1	23.2	17.9	19.5	20.6
Poor		3.1	4.5	4.4	5.7	3.7	3.6	4.0
Memory compared to one year ago / last interview								
Better	8.0	5.9	2.7	2.7	2.5	3.0	2.4	1.7
Worse	12.0	11.2	17.5	12.3	20.8	18.4	16.5	78.7
No change	80.0	82.9	79.8	85.0	76.7	78.6	81.1	19.5
Difficulty remembering clearly 2								
Strongly agree	6.9	-	-	-	-	-	-	-
Agree	51.4	-	-	-	-	-	-	-
Disagree	35.8	-	-	-	-	-	-	-
Strongly disagree	5.9	-	-	-	-	-	-	-
Month								
Correct	-	-	98.4	96.0	96.7	97.7	97.5	96.5
Incorrect	-	-	1.6	4.0	3.3	2.3	2.5	3.5
Day								
Correct	-	-	85.9	79.3	79.9	84.0	83.0	84.0
Incorrect	-	-	14.1	20.7	20.1	16.0	17.0	16.0
Year								
Correct	-	-	99.0	95.4	95.8	97.6	98.0	95.9
Incorrect	-	-	1.0	4.6	4.2	2.4	2.0	4.1
Day of week								
Correct	-	-	98.8	96.2	95.9	97.6	97.1	95.8
Incorrect	-	-	1.2	3.8	4.1	2.4	2.9	4.1

*Weighted

Table 6. (cont.)

Question	HRS 92	HRS 94	HRS 96	AHEAD 93	AHEAD 95	HRS 98	HRS 00	HRS 02
Scissors								
Correct	-	-	99.1	98.9	98.6	99.1	99.3	98.9
Incorrect	-	-	0.9	1.1	1.4	0.9	0.7	1.1
Cactus								
Correct	-	-	93.6	85.7	86.5	92.6	91.8	91.7
Incorrect	-	-	6.4	14.3	13.5	7.4	8.2	8.3
President								
Correct	-	-	95.7	91.5	91.9	96.4	95.6	96.2
Incorrect	-	-	4.3	8.5	8.1	3.6	4.4	3.8
Vice-president								
Correct	-	-	76.5	74.7	69	85.9	91.8	71.1
Incorrect	-	-	23.5	25.3	31	14.1	8.2	28.9
Backwards count (20)								
0 - incorrect on both tries	-	-	2.8	6.6	4.7	3.9	3.9	3.8
1 - correct on 2nd try only	-	-	0.1	3.6	0.1	0.1	0.3	0.1
2 - correct on first try	-	-	97.1	89.8	95.2	96	95.8	96.1
Backwards count (86)								
0 - incorrect on both tries	-	-	9.5	-	14.2	12.2	12.2	11.7
1 - correct on 2nd try only	-	-	0.1	-	0.1	0.2	0.3	0.1
2 - correct on first try	-	-	90.4	-	85.7	87.6	87.5	88.2

Table 7. Mean number of correct responses* for cognition measures in HRS and AHEAD: Age-eligible self-respondents
(Standard deviations in parentheses)

Question	HRS 92	HRS 94	HRS 96	AHEAD 93	AHEAD 95	HRS 98	HRS 00	HRS 02
Immediate word recall (mean count)	7.61 (2.65) n=9090	8.09 (3.07) n=7968	6.10 (1.65) n=7901	4.57 (1.87) n=6446	4.68 (1.83) n=5363	5.75 (1.81) n=18286	5.55 (1.81) n=16413	5.51 (1.82) n=15051
Delayed word recall	5.54 (2.83) n=9020	6.22 (3.25) n=7832	5.10 (2.03) n=7881	3.17 (2.20) n=6386	3.40 (2.13) n=5239	4.69 (2.18) n=18106	4.53 (2.14) n=16290	4.52 (2.17) n=15001
Total recall	13.17 (5.10) n=9018	14.34 (5.96) n=7832	11.21 (3.42) n=7881	7.78 (3.81) n=6356	8.17 (3.60) n=5239	10.48 (3.69) n=18106	10.12 (3.67) n=16290	10.05 (3.71) n=15001
Serial 7's	-	-	3.77 (1.55) n=7673	3.45 (1.61) n=7673	3.35 (1.69) n=5086	3.64 (1.62) n=17798	3.65 (1.68) n=15974	3.67 (1.71) n=14698
Vocabulary score4	- -	- -	5.46 (2.07) n=7921	- -	5.35 (2.15) n=5381		5.53 (2.13) n=9386	5.66 (2.04) n=9423
WAIS similarity test score	6.34 (2.92) n=8671	6.92 (2.88) n=593	- -	5.59^5 (2.76) n=537	- -	- -	- -	- -
TICS (Range from 0-10)	-	-	9.42 (.92) n=7878	9.04 (1.44) n=6371	9.09 (1.30) n=5274	9.43 (1.08) n=11695	9.46 (1.18) n=9300	9.24 (1.31) n=9442
Total score (Range from 0-35)	-	-	24.50 (4.45) n=7621	20.76 (5.15) n=5639	20.91 (5.00) n=4912	23.13 (4.97) n = 11188	22.18 (4.98) n=8808	22.09 (5.17) n=9063

*Weighted
[1] Derived by summing immediate recall and delayed recall score
[2] Derived by summing day, month, year, day of week, scissors, cactus, president, vice-president, and backwards count from 20
[3] Derived by summing immediate recall, delayed recall, serial 7's, and 10-point TICS score
[4] Recoded 0,1,2 and combined across both lists.

Table 8. Frequency distributions* for cognition measures in HRS and AHEAD: Proxy-respondents

Question	HRS 92	HRS 94	HRS 96 N=523	AHEAD 93 N=791	AHEAD 95 N=856	HRS/AHD 98 N=1356	HRS 00 N=1460	HRS 02
Memory rating								
Excellent	-	-	88	72	67	116	120	114
Very good	-	-	155	117	116	195	211	233
Good	-	-	167	201	197	355	360	396
Fair	-	-	82	187	194	328	373	297
Poor	-	-	29	209	279	356	391	417
Missing	-	-	2	5	3	6	5	2
Judgments / decisions rating								
Excellent	-	-	121	58	47	109	112	130
Very good	-	-	170	157	116	215	213	248
Good	-	-	144	186	198	305	298	323
Fair	-	-	51	161	179	247	289	239
Poor	-	-	36	217	315	413	438	437
Missing	-	-	1	12	1	67	110	82
Organize daily activities rating								
Excellent	-	-	145	84	40	120	134	131
Very good	-	-	150	150	116	222	205	243
Good	-	-	145	185	220	306	326	331
Fair	-	-	41	138	153	203	233	234
Poor	-	-	41	224	326	437	455	437
Missing	-	-	1	10	1	68	107	83
Lost in familiar environment								
Yes	-	-	26	153	226	307	286	290
No	-	-	495	622	624	970	1051	1074
Missing	-	-	2	16	6	79	123	95
Wander off								
Yes	-	-	6	34	66	98	74	88
No	-	-	515	748	788	1190	1273	1281
Missing	-	-	2	9	2	68	113	90

* Unweighted

Table 8 (cont.)

Question	HRS 92	HRS 94	HRS 96 N=523	AHEAD 93 N=791	AHEAD 95 N=856	HRS/AHD 98 N=1356	HRS 00	HRS 02
Left alone								
Yes	-	-	457	639	644	1024	1036	1065
No	-	-	66	143	210	270	313	315
Missing	-	-	0	9	2	62	111	79
Hear things not there								
Yes	-	-	20	121	169	221	233	208
No	-	-	500	657	679	1058	1104	1140
Missing	-	-	3	13	8	77	123	111
Angry / hostile								
Most of the time	-	-	18	34	45	40	53	72
Some of the time	-	-	92	199	205	332	316	312
Never	-	-	409	546	602	902	969	966
Missing	-	-	4	12	4	82	122	109
Difficulty falling asleep								
Most of the time	-	-	49	159	135	186	187	157
Some of the time	-	-	137	266	253	362	414	414
Never	-	-	328	350	445	689	717	729
Missing	-	-	9	16	23	119	142	159
Dangerous behavior								
Most of the time	-	-	4	11	13	18	18	18
Some of the time	-	-	25	86	87	112	120	103
Never	-	-	491	681	748	1148	1204	1231
Missing	-	-	3	13	8	78	118	107
Pacing / rocking								
Most of the time	-	-	7	19	31	44	49	40
Some of the time	-	-	14	59	49	88	100	96
Never	-	-	499	701	773	1148	1194	1220
Missing	-	-	3	12	3	76	117	103
Thinks people plotting / harming								
Most of the time	-	-	9	14	22	37	38	32
Some of the time	-	-	17	61	74	94	116	106
Never	-	-	494	705	756	1152	1193	1223
Missing	-	-	3	11	4	73	113	98
Excessive alcohol consumption								
Most of the time	-	-	18	0	4	8	8	8
Some of the time	-	-	27	15	12	26	23	18
Never	-	-	477	764	837	1251	1321	1346
Missing	-	-	1	12	3	71	108	87

Table 9. Percentage distributions* for cognition measures in HRS and AHEAD: Proxy respondents

Question	HRS 92	HRS 94	HRS 96	AHEAD 93	AHEAD 95	HRS/AHD 98	HRS 00	HRS 02
Memory rating								
Excellent	-	-	16.7	9.0	7.6	9.2	10.0	9.7
Very good	-	-	31.8	15.4	16.9	17.9	17.3	19.1
Good	-	-	32.6	26.7	27.2	29.5	27.7	31.5
Fair	-	-	14.3	22.3	21.4	24.2	26.2	19.1
Poor	-	-	4.6	26.6	26.9	19.2	18.7	20.5
Judgments / decisions rating								
Excellent	-	-	23.3	8.0	6.8	10.1	9.9	12.4
Very good	-	-	34.8	20.8	16.5	20.4	19.8	22.2
Good	-	-	26.5	24.1	27.3	27.6	27.2	27.5
Fair	-	-	9.4	20.3	20.2	19.2	21.7	17.7
Poor	-	-	6.0	26.8	29.2	22.7	21.5	20.3
Organize daily activities rating								
Excellent	-	-	28.5	11.0	5.7	11.8	11.9	12.1
Very good	-	-	31.5	19.6	16.8	21.3	19.7	22.9
Good	-	-	26.6	24.5	30.3	28.7	29.3	29.1
Fair	-	-	6.9	17.2	16.9	15.4	17.4	15.5
Poor	-	-	6.5	27.7	30.3	22.8	21.7	20.4
Lost in familiar environment								
Yes	-	-	3.8	19.4	20.6	16.6	13.1	13.7
No	-	-	96.2	80.6	79.4	83.4	86.9	86.3
Wander off								
Yes	-	-	0.7	4.1	4.0	4.2	2.2	3.4
No	-	-	99.3	95.9	96.0	95.8	97.8	96.6

*Weighted

Table 9. (cont.)

Question	HRS 92	HRS 94	HRS 96	AHEAD 93	AHEAD 95	HRS/AHD 98	HRS 00	HRS 02
Left alone								
Yes	-	-	87.2	82.4	82.0	83.5	83.5	84.5
No	-	-	12.8	17.6	18.0	16.5	16.5	15.5
Hear things not there								
Yes	-	-	3.4	15.0	17.4	12.3	12.9	10.7
No	-	-	96.6	85.0	82.6	87.7	87.1	89.3
Angry / hostile								
Most of the time	-	-	3.2	3.6	4.3	2.9	3.1	4.3
Some of the time	-	-	17.0	25.8	23.9	24.0	22.7	19.9
Never	-	-	79.8	70.6	71.8	73.1	74.2	75.8
Difficulty falling asleep								
Most of the time	-	-	9.9	21.1	16.5	15.1	15.3	13.1
Some of the time	-	-	29.5	33.5	34.1	29.5	30.5	31.3
Never	-	-	60.6	45.4	49.4	55.4	54.2	55.6
Dangerous behavior								
Most of the time	-	-	0.5	1.1	0.9	1.3	1.0	0.8
Some of the time	-	-	4.5	11.8	8.5	7.6	8.4	5.3
Never	-	-	95.0	87.1	90.6	91.1	90.6	93.9
Pacing / rocking								
Most of the time	-	-	0.8	2.2	3.0	2.9	2.7	1.4
Some of the time	-	-	2.5	6.7	5.4	5.0	7.0	5.8
Never	-	-	96.7	91.1	91.6	92.1	90.3	92.8
Thinks people plotting / harming								
Most of the time	-	-	1.7	1.7	2.1	2.2	2.4	1.5
Some of the time	-	-	2.5	7.0	7.9	4.0	6.5	5.7
Never	-	-	95.8	91.3	90.0	93.8	91.1	92.8
Excessive alcohol consumption								
Most of the time	-	-	4.2	0	0.4	0.7	1.3	1.6
Some of the time	-	-	5.3	1.9	1.4	2.6	2.6	1.5
Never	-	-	90.5	98.1	98.2	96.7	96.1	96.9

VIII. Appendix - SAS code for creating constructed variables

HRS 1992

```
*Immediate Recall;
if v5105=. then immrec92=.;
  else immrec92=v5105;

*Delayed Recall;
if v5126=. then delrec92=.;
  else delrec92=v5126;

*Total Recall;
if immrec92=. or delrec92=. then totrec92=.;
  else totrec92=immrec92+delrec92;

*Similarities;
if v5106=. or v5107=. or v5108=. or v5109=. or v5110=. or v5111=. or
  v5112=. then wsim92=.;
else wsim92=(v5106+v5107+v5108+v5109+v5110+v5111+v5112);

label    immrec92 = 'Immediate Word Recall- HRS92'
         delrec92 = 'Delayed Word Recall - HRS92'
         totrec92 = 'Total Recall - HRS92'
         wsim92 = 'Similarities - HRS92';
```

HRS 1994

```
*Immediate Recall;
if w5832=. or w5832=96 then immrec94=.;
  else immrec94=w5832;

*Delayed Recall;
if w5877=. or w5877=96 then delrec94=.;
  else delrec94=w5877;

*Total Recall;
if immrec94=. or delrec94=. then totrec94=.;
  else totrec94=immrec94+delrec94;

/*recoding WAIS variables*/
array OLD [7] w9270 w9271 w9272 w9273 w9274 w9275 w9276;
array NEW [7] w9270 w9271 w9272 w9273 w9274 w9275 w9276;

do i=1 to 7;
  if OLD[i] eq 9 or OLD[i] eq . then NEW[i]=.;
   else NEW[i]=OLD[I];
   end;
```

if rw9270 = . or rw9271 = . or rw9272 = . or rw9273 = . or rw9274 = .
  or rw9275 = . or rw9276 = . then wsim94 = .;
  else wsim94 = (rw9270 + rw9271 + rw9272 + rw9273 + rw9274 + rw9275 + rw9276);

label   immrec94 = 'Immediate Word Recall- HRS94'
         delrec94 = 'Delayed Word Recall - HRS94'
         totrec94 = 'Total Recall - HRS94'
         wsim94 = 'Similarities - HRS94';

AHEAD 1993

*Backwards Count;
if v379 eq 1 then bwc20_93=2;
 else if v379 eq 2 then bwc20_93=1;
  else if v379 eq 5 then bwc20_93=0;

*Immediate & Delayed Recall;
immrec93=immwordc;
delrec93=delwordc;

if immrec93=. or delrec93=. then totrec93=.;
  else totrec93 = immrec93+delrec93;

*Serial 7's;
if v384 eq 93 then ser7_93=1;
  else if v384 ne 93 and v384 ne .R then ser7_93=0;
    else if v384=.D then ser7_93=0;
if (v384 - v385) eq 7 then ser7_93 +1;
if (v385 - v386) eq 7 then ser7_93 +1;
if (v386 - v387) eq 7 then ser7_93 +1;
if (v387 - v388) eq 7 then ser7_93 +1;
if v384=.R then ser7_93=.;

*Date Naming;
if v373=1 then mo93=1;
  else if v373=5 then mo93=0;
if v374=1 then dy93=1;
  else if v374=5 then dy93=0;
if v375=1 then yr93=1;
  else if v375=5 then yr93=0;
if v376=1 then dw93=1;
  else if v376=5 then dw93=0;
if v380=1 then scis93=1;
  else if v380=5 then scis93=0;
if v381=1 then cact93=1;
  else if v381=5 then cact93=0;
if v382=1 then pres93=1;
  else if v382=5 then pres93=0;

```
if v383=1 then vp93=1;
  else if v383=5 then vp93=0;

array irec[11] v368A1 - v368A11;
if V362 eq 1 and (v368A1 ne . and V368A1 ne .R) then do;
  immrec93 = 0;
  do i = 1 to 11;
    if 1 <= irec[i] <= 10 then immrec93 + 1;
    else if 11 <= irec[i] <= 13 then immrec93=immrec93;
  end;
end;
else do;
  if V362 eq . or V368A1 eq . or V368A1 eq .R then immrec93 = .;
  if V368A1 = 96 then immrec93 = 0;
end;

array drec[11] v393A1 - V393A11;
if V393A1 ne . then do;
  delrec93 = 0;
  do i = 1 to 11;
    if 1 <= drec[i] <= 10 then delrec93 + 1;
    else if 11 <= drec[i] <= 13 then delrec93=delrec93;
  end;
end;
else do;
  if v362 = . or V393A1 = . then delrec93 = .;
  if V393A1 = 96 then delrec93 = 0;
end;

if immrec93=. or delrec93=. then totrec93=.;
  else totrec93=immrec93+delrec93;


TICS93=(mo93 + dy93 + yr93 + dw93 + scis93 + cact93 + pres93
    + vp93 + bwc20_93);
if v373=. or v374=. or v375=. or v376=. or v380=. or v381=. or v382=.
  or v383=. or bwc20_93=. then TICS93 =.;

Totcog93 = TICS93 + immrec93 + delrec93 + ser7_93;
if TICS93=. or immrec93=. or delrec93=. or ser7_93=. then Totcog93=.;


if mo93 ne . or dy93 ne . or yr93 ne . or dw93 ne .
  then date93 = (mo93 + dy93 + yr93 + dw93);
    else date93=.;

if v2110A1=. or v2110A2=. or v2110A3=. or v2110A4=. or v2110A5=.
  or v2110A6=. then wsim93=.;
    else wsim93=(v2110A1+v2110A2+v2110A3+v2110A4+v2110A5+v2110A6);
```

```
label immrec93 = 'Immediate Word Recall- AHD93'
      delrec93 = 'Delayed Word Recall - AHD93'
          totrec93 = 'Total Recall - AHD93'
          bwc20_93 = 'Backwards Count from 20 - AHD93'
          date93 = 'Dates (0-4) - AHD93'
          mo93 = 'Date: Month - AHD93'
          dy93 = 'Date: Day - AHD93'
          yr93 = 'Date: Year - AHD93'
          dw93 = 'Date: day of week - AHD93'
          scis93 = 'Scissors - AHD93'
          cact93 = 'Cactus - AHD93'
          pres93 = 'President - AHD93'
          vp93 = 'Vice President - AHD93'
          ser7_93 = 'Serial 7s - AHD93'
          TICS93 = 'TICS Summary Var - AHD93'
          totcog93 = 'Total Cognition Summary - AHD93';
```

AHEAD 1995

```
/* Immediate Recall */
array immrec[11] D1174M1 - D1174M11;
if (D1174M1 ne .) or (D1174M1 ne 95) or (D1174M1 ne 97)
or (D1174M1 ne 99) then do;
  immrec95 = 0;
  do i = 1 to 11;
    if 1 <= immrec[i] <= 40 then immrec95 + 1;
  end;
end;

if D1174M1=. or D1174M1=.95 or D1174M1=97 or D1174M1=99 then immrec95 = .;

/* Delayed Recall */
array delrec[11] D1314M1 - D1314M11;
if (D1314M1 ne .) or (D1314M1 ne 95)or (D1314M1 ne 97)
or (D1314M1 ne 99) then do;
  delrec95 = 0;
  do i = 1 to 11;
    if 1 <= delrec[i] <= 40 then delrec95 + 1;
  end;
end;
if D1314M1=. or D1314M1=.95 or D1314M1=97 or D1314M1=99 then delrec95 = .;

/* Total Recall */
if immrec95=. or delrec95=. then totrec95=.;
  else totrec95=immrec95+delrec95;

/* Serial 7s */
```

if D1305 eq 93 then ser7_95=1;
  else if D1305 ne 93 and D1305 ne . then ser7_95=0;
if (D1305 - D1306) eq 7 then ser7_95 + 1;
if (D1306 - D1307) eq 7 then ser7_95 + 1;
if (D1307 - D1308) eq 7 then ser7_95 + 1;
if (D1308 - D1309) eq 7 then ser7_95 + 1;
if D1305=999 or D1305=. then ser7_95 =.;

/*Backwards Count - 20 & 86 */
if D1228 eq 1 then bwc20_95=1;
  else if D1205 eq 1 then bwc20_95=2;
  else if D1228 eq 9 or D1205 eq 9 or D1205=. then bwc20_95=.;
    else bwc20_95=0;

if D1287 eq 1 then bwc86_95=1;
  else if D1264 eq 1 then bwc86_95=2;
  else if D1287 eq 9 or D1264 eq 9 or D1264=. then bwc86_95=.;
    else bwc86_95=0;

/*Recoding DK & refusals as missing data*/

/*Date Naming */
if D1179=5 or D1179=7 or D1179=8 then Mo95=0;
  else if D1179=9 or D1179=. then Mo95=.;
    else if D1179=1 then Mo95=1;

if D1180=5 or D1180=7 or D1180=8 then Dy95=0;
  else if D1180=9 or D1180=. then Dy95=.;
    else if D1180=1 then Dy95=1;

if D1181=5 or D1181=7 or D1181=8 then Yr95=0;
  else if D1181=9 or D1181=. then Yr95=.;
    else if D1181=1 then Yr95=1;

if D1182=5 or D1182=7 or D1182=8 then Dw95=0;
  else if D1182=9 or D1182=. then Dw95=.;
    else if D1182=1 then Dw95=1;

/* Word Recognition */
if D1301=5 or D1301=7 or D1301=8 then Scis95=0;
  else if D1301=1 then Scis95=1;
    else if D1301=. or D1301=9 then Scis95=.;

if D1302=5 or D1302=7 or D1302=8 then Cact95=0;
  else if D1302=1 then Cact95=1;
    else if D1302=. or D1302=9 then Cact95=.;

/* Knowledge Questions (Pres/VP)*/

```
if D1303=5 or D1303=7 or D1303=8 then Pres95=0;
  else if D1303=1 then Pres95=1;
    else if D1303=. or D1303=9 then Pres95=.;


if D1304=5 or D1304=7 or D1304=8 then Vp95=0;
  else if D1304=1 then Vp95=1;
    else if D1304=. or D1304=9 then Vp95=.;


/* WAIS vocabulary items */
if D1320_1=1 then D1320_1r=0;
  else if D1320_1=2 then D1320_1r=1;
    else if D1320_1=3 then D1320_1r=2;
          else if D1320_1=7 or D1320_1=9 then D1320_1r=.;
if D1320_2=1 then D1320_2r=0;
  else if D1320_2=2 then D1320_2r=1;
    else if D1320_2=3 then D1320_2r=2;
          else if D1320_2=7 or D1320_2=9 then D1320_2r=.;
if D1323_1=1 then D1323_1r=0;
  else if D1323_1=2 then D1323_1r=1;
    else if D1323_1=3 then D1323_1r=2;
          else if D1323_1=7 or D1323_1=9 then D1323_1r=.;
if D1323_2=1 then D1323_2r=0;
  else if D1323_2=2 then D1323_2r=1;
    else if D1323_2=3 then D1323_2r=2;
          else if D1323_2=7 or D1323_2=9 then D1323_2r=.;
if D1326_1=1 then D1326_1r=0;
  else if D1326_1=2 then D1326_1r=1;
    else if D1326_1=3 then D1326_1r=2;
          else if D1326_1=7 or D1326_1=9 then D1326_1r=.;
if D1326_2=1 then D1326_2r=0;
  else if D1326_2=2 then D1326_2r=1;
    else if D1326_2=3 then D1326_2r=2;
          else if D1326_2=7 or D1326_2=9 then D1326_2r=.;
if D1329_1=1 then D1329_1r=0;
  else if D1329_1=2 then D1329_1r=1;
    else if D1329_1=3 then D1329_1r=2;
          else if D1329_1=7 or D1329_1=9 then D1329_1r=.;
if D1329_2=1 then D1329_2r=0;
  else if D1329_2=2 then D1329_2r=1;
    else if D1329_2=3 then D1329_2r=2;
          else if D1329_2=7 or D1329_2=9 then D1329_2r=.;
if D1332_1=1 then D1332_1r=0;
  else if D1332_1=2 then D1332_1r=1;
    else if D1332_1=3 then D1332_1r=2;
          else if D1332_1=7 or D1332_1=9 then D1332_1r=.;
if D1332_2=1 then D1332_2r=0;
  else if D1332_2=2 then D1332_2r=1;
    else if D1332_2=3 then D1332_2r=2;
          else if D1332_2=7 or D1332_2=9 then D1332_2r=.;
```

```
/*Computing vocabulary summary scores*/

if D1320_1r ne . then vlst1_95=(D1320_1r+D1323_1r+D1326_1r+D1329_1r+D1332_1r);
  else if D1320_1=. then vlst1_95=.;
if D1320_2r ne . then vlst2_95=(D1320_2r+D1323_2r+D1326_2r+D1329_2r+D1332_2r);
  else if D1320_2=. then vlst2_95=.;

array voc1 [5] d1320_1 d1323_1 d1326_1 d1329_1 d1332_1;
array voc2 [5] d1320_2 d1323_2 d1326_2 d1329_2 d1332_2;
array voc_comb voc1_95 voc2_95 voc3_95 voc4_95 voc5_95;

misvoc95 = 0;
do i=1 to 5;
  if (voc1[i] eq 1) or (voc2[i] eq 1) then voc_comb[i] = 0;
  else if (voc1[i] eq 2) or (voc2[i] eq 2) then voc_comb[i] = 1;
  else if (voc1[i] eq 3) or (voc2[i] eq 3) then voc_comb[i] = 2;
  else voc_comb[i]=.;
  if voc_comb[i] eq . then misvoc95=misvoc95+1;
  end;

if misvoc95 = 0 then vocab95 = voc1_95 + voc2_95 + voc3_95 + voc4_95 + voc5_95;
  else vocab95=.;

  /*Computing TICS & Total Score Summary Measures*/
TICS95 = (Mo95 + Dy95 + Yr95 + Dw95 + Scis95 + Cact95
    + Pres95 + Vp95 + bwc20_95);
if Mo95=. or Dy95=. or Yr95=. or Dw95=. or Scis95=.
  or Cact95=. or Pres95=. or Vp95=. or bwc20_95=. then TICS95=.;

Totcog95= TICS95 + immrec95 + delrec95 + ser7_95;
if TICS95=. or immrec95=. or delrec95=. or ser7_95=. then Totcog95=.;


if mo95 ne . or dy95 ne . or yr95 ne . or yr95 ne .
  then date95 = (mo95 + dy95 + yr95 + dw95);
    else date95=.;

/* Jorm IQCODE Scoring */
array base [16] d1072 d1077 d1082 d1087 d1092 d1097 d1102 d1107 d1112 d1117
          d1122 d1127 d1132 d1135 d1138 d1141;
array better [16] d1073 d1078 d1083 d1088 d1093 d1098 d1103 d1108 d1113 d1118
          d1123 d1128 d1133 d1136 d1139 d1142;
array worse [16] d1074 d1079 d1084 d1089 d1094 d1099 d1104 d1109 d1114 d1119
          d1124 d1129 d1134 d1137 d1140 d1143;
array pc [16] pc95_8 pc95_9 pc95_10 pc95_11 pc95_12 pc95_13 pc95_14 pc95_15
          pc95_16 pc95_17 pc95_18 pc95_19 pc95_20 pc95_21 pc95_22 pc95_23;
missjm95=0;

do i=1 to 16;
```

```
   if base[i] eq 1 and better[i] in (1,2) then pc[i]=better[i];
   else if base[i] eq 2 then pc[i]=3;
   else if base[i] eq 3 and worse[i] in (4,5) then pc[i]=worse[i];
   else pc[i]=.;
   if pc[i] eq . then missjm95=missjm95+1;
   end;

if missjm95 = 0 then
iqtot95=pc95_8+pc95_9+pc95_10+pc95_11+pc95_12+pc95_13+pc95_14+pc95_15+
        pc95_16+pc95_17+pc95_18+pc95_19+pc95_20+pc95_21+pc95_22+pc95_23;
  else iqtot95=.;

avgiq95 = (iqtot95/16);


array behav [10] D1144--D1153;
array newpc  [10] PC95_24 PC95_25 PC95_26 PC95_27 PC95_28 PC95_29
          PC95_30 PC95_31 PC95_32 PC95_33;

do i=1 to 10;
  if 1 le behav[i] le 5 then newpc[i]=behav[i];
    else if behav[i] in (8,9,.) then newpc[i]=.;
  end;
drop i;

judge95 = .;
  if 1 le D1061 le 5 then judge95=D1061;
orgize95 = .;
  if 1 le D1066 le 5 then orgize95=D1066;
slfmem95=.;
  if 1 le D1161 le 5 then slfmem95=D1161;
pstmem95=.;
  if 1 le D1162 le 5 then pstmem95=D1162;


label    immrec95 = 'Immediate Word Recall- AHD95'
         delrec95 = 'Delayed Word Recall - AHD95'
         totrec95 = 'Total Recall - AHD95'
         bwc20_95 = 'Backwards Count from 20 - AHD95'
         date95 = 'Dates (0-4) - AHD95'
         mo95 = 'Date: Month - AHD95'
         dy95 = 'Date: Day - AHD95'
         yr95 = 'Date: Year - AHD95'
         dw95 = 'Date: day of week - AHD95'
         scis95 = 'Scissors - AHD95'
         cact95 = 'Cactus - AHD95'
         pres95 = 'President - AHD95'
         vp95 = 'Vice President - AHD95'
         ser7_95 = 'Serial 7s - AHD95'
```

```
          TICS95 = 'TICS Summary Var - AHD95'
          totcog95 = 'Total Cognition Summary - AHD95'
          vocab95 = 'WAIS Vocabulary - AHD95'
          MISSJM95='JORM IQCODE: NUMBER MISSING - AHD95'
          IQTOT95 = 'JORM IQCODE: TOTAL SCORE - AHD95'
          AVGIQ95 = 'JORM IQCODE: AVERAGE SCORE - AHD95';
```

HRS 1996

```
/* Immediate Recall */
immrec96=.;
array irec[11] E1174M1 - E1174M11;
if E1174M1 ne . or E1174M1 ne 95 or E1174M1 ne 97
or E1174M1 ne 99 then do;
  immrec96 = 0;
  do i = 1 to 11;
    if 1 <= irec[i] <= 40 then immrec96 + 1;
  end;
end;

if E1174M1 = . or E1174M1 = 95 or E1174M1 = 97 or E1174M1 = 99
then immrec96 = .;

/* Delayed Recall */
array drec[11] E1314M1 - E1314M11;
if E1314M1 ne . or E1314M1 ne 95 or E1314M1 ne 97
or E1314M1 ne 99 then do;
  delrec96 = 0;
  do i = 1 to 11;
    if 1 <= drec[i] <= 40 then delrec96 + 1;
  end;
end;
if E1314M1 = . or E1314M1 = 95 or E1314M1 = 97 or E1314M1 = 99
then delrec96 = .;

/* Total Recall */
if immrec96=. or delrec96=. then totrec96=.;
  else totrec96=immrec96+delrec96;

/* Serial 7's */
if E1305 eq 93 then ser7_96=1;
  else if E1305 ne 93 and E1305 ne . then ser7_96=0;
if (E1305 - E1306) eq 7 then ser7_96 + 1;
if (E1306 - E1307) eq 7 then ser7_96 + 1;
if (E1307 - E1308) eq 7 then ser7_96 + 1;
if (E1308 - E1309) eq 7 then ser7_96 + 1;
if e1305=999 or e1305=. then ser7_96 =.;
```

```
/*Backwards count recoding - 20 & 86*/
if E1228 eq 1 then bwc20_96=1;
   else if E1205 eq 1 then bwc20_96=2;
   else if E1228 eq 9 or E1205 eq 9 or E1205 eq . then bwc20_96=.;
      else bwc20_96=0;

if E1287 eq 1 then bwc86_96=1;
   else if E1264 eq 1 then bwc86_96=2;
   else if E1287 eq 9 or E1264 eq 9 or E1264 eq . then bwc86_96=.;
      else bwc86_96=0;

/*Recoding DK & refusals as missing data*/
Title 'HRS3 - Cognition Measures';
/*recoding self-rated memory question; DK & RF = missing*/
if e1161=8 or e1161=9 or e1161=. then e1161_r=.;
   else e1161_r=e1161;
/*recoding memory compared to last interview question; DK & RF = missing*/
if e1162=8 or e1162=9 or e1162=. then e1162_r=.;
   else e1162_r=e1162;

/*recoding date and day of week question;
 RF = missing; other/DK=incorrect*/
if e1179=5 or e1179=7 or e1179=8 then mo96=0;
   else if e1179=9 or e1179=. then mo96=.;
   else if e1179=1 then mo96=1;

if e1180=5 or e1180=7 or e1180=8 then dy96=0;
   else if e1180=9 or e1180=. then dy96=.;
   else if e1180=1 then dy96=1;

if e1181=5 or e1181=7 or e1181=8 then yr96=0;
   else if e1181=9 or e1181=. then yr96=.;
   else if e1181=1 then yr96=1;

if e1182=5 or e1182=7 or e1182=8 then dw96=0;
   else if e1182=9 or e1182=. then dw96=.;
   else if e1182=1 then dw96=1;

/*recoding word recognition questions (scissors/cactus)*/
if e1301=5 or e1301=7 or e1301=8 then scis96=0;
   else if e1301=1 then scis96=1;
   else if e1301=. or e1301=9 then scis96=.;

if e1302=5 or e1302=7 or e1302=8 then cact96=0;
   else if e1302=1 then cact96=1;
   else if e1302=. or e1302=9 then cact96=.;

/*recoding knowledge questions (Pres/VP)*/
if e1303=5 or e1303=7 or e1303=8 then pres96=0;
```

```
  else if e1303=1 then pres96=1;
  else if e1303=. or e1303=9 then pres96=.;

if e1304=5 or e1304=7 or e1304=8 then vp96=0;
  else if e1304=1 then vp96=1;
  else if e1304=. or e1304=9 then vp96=.;

/*Recoding WAIS vocabulary items*/
if e1320_1=1 then e1320_1r=0;
  else if e1320_1=2 then e1320_1r=1;
    else if e1320_1=3 then e1320_1r=2;
         else if e1320_1=7 or e1320_1=9 then e1320_1r=.;
if e1320_2=1 then e1320_2r=0;
  else if e1320_2=2 then e1320_2r=1;
    else if e1320_2=3 then e1320_2r=2;
         else if e1320_2=7 or e1320_2=9 then e1320_2r=.;
if e1323_1=1 then e1323_1r=0;
  else if e1323_1=2 then e1323_1r=1;
    else if e1323_1=3 then e1323_1r=2;
         else if e1323_1=7 or e1323_1=9 then e1323_1r=.;
if e1323_2=1 then e1323_2r=0;
  else if e1323_2=2 then e1323_2r=1;
    else if e1323_2=3 then e1323_2r=2;
         else if e1323_2=7 or e1323_2=9 then e1323_2r=.;
if e1326_1=1 then e1326_1r=0;
  else if e1326_1=2 then e1326_1r=1;
    else if e1326_1=3 then e1326_1r=2;
         else if e1326_1=7 or e1326_1=9 then e1326_1r=.;
if e1326_2=1 then e1326_2r=0;
  else if e1326_2=2 then e1326_2r=1;
    else if e1326_2=3 then e1326_2r=2;
         else if e1326_2=7 or e1326_2=9 then e1326_2r=.;
if e1329_1=1 then e1329_1r=0;
  else if e1329_1=2 then e1329_1r=1;
    else if e1329_1=3 then e1329_1r=2;
         else if e1329_1=7 or e1329_1=9 then e1329_1r=.;
if e1329_2=1 then e1329_2r=0;
  else if e1329_2=2 then e1329_2r=1;
    else if e1329_2=3 then e1329_2r=2;
         else if e1329_2=7 or e1329_2=9 then e1329_2r=.;
if e1332_1=1 then e1332_1r=0;
  else if e1332_1=2 then e1332_1r=1;
    else if e1332_1=3 then e1332_1r=2;
         else if e1332_1=7 or e1332_1=9 then e1332_1r=.;
if e1332_2=1 then e1332_2r=0;
  else if e1332_2=2 then e1332_2r=1;
    else if e1332_2=3 then e1332_2r=2;
         else if e1332_2=7 or e1332_2=9 then e1332_2r=.;
```

```
/*Computing vocabulary summary scores */
if e1320_1r ne . then vlist1_96=(e1320_1r+e1323_1r+e1326_1r+e1329_1r+e1332_1r);
  if e1320_1=. then vlist1_96=.;
if e1320_2r ne . then vlist2_96=(e1320_2r+e1323_2r+e1326_2r+e1329_2r+e1332_2r);
  if e1320_2=. then vlist2_96=.;


/* TICS Summary Score */
TICS96 = (mo96 + dy96 + yr96 + dw96 + scis96 + cact96 + pres96 + vp96 +
      bwc20_96);
if mo96=. or dy96=. or yr96=. or dw96=. or scis96=.
  or cact96=. or pres96=. or vp96=. or bwc20_96=. then TICS96=.;


/* Total Cognition Summary Score */
Totcog96= TICS96 + immrec96 + delrec96 + ser7_96;
if TICS96=. or immrec96=. or delrec96=. or ser7_96=. then Totcog96=.;


array voc1 [5] e1320_1 e1323_1 e1326_1 e1329_1 e1332_1;
array voc2 [5] e1320_2 e1323_2 e1326_2 e1329_2 e1332_2;
array voc_comb voc1_96 voc2_96 voc3_96 voc4_96 voc5_96;


missvoc = 0;
do i=1 to 5;
  if (voc1[i] eq 1) or (voc2[i] eq 1) then voc_comb[i] = 0;
  else if (voc1[i] eq 2) or (voc2[i] eq 2) then voc_comb[i] = 1;
  else if (voc1[i] eq 3) or (voc2[i] eq 3) then voc_comb[i] = 2;
  else voc_comb[i]=.;
  if voc_comb[i] eq . then missvoc=missvoc+1;
  end;


if missvoc = 0 then vocab96 = voc1_96 + voc2_96 + voc3_96 + voc4_96 + voc5_96;
  else vocab96=.;


if mo96 ne . or dy96 ne . or yr96 ne . or dw96 ne .
  then date96 = (mo96 + dy96 + yr96 + dw96);
    else date96=.;
```

```
/* Jorm IQCODE Scoring */
array base [16] e1072 e1077 e1082 e1087 e1092 e1097 e1102 e1107 e1112 e1117
          e1122 e1127 e1132 e1135 e1138 e1141;
array better [16] e1073 e1078 e1083 e1088 e1093 e1098 e1103 e1108 e1113 e1118
          e1123 e1128 e1133 e1136 e1139 e1142;
array worse [16] e1074 e1079 e1084 e1089 e1094 e1099 e1104 e1109 e1114 e1119
          e1124 e1129 e1134 e1137 e1140 e1143;
array pc [16] pc96_8 pc96_9 pc96_10 pc96_11 pc96_12 pc96_13 pc96_14 pc96_15
        pc96_16 pc96_17 pc96_18 pc96_19 pc96_20 pc96_21 pc96_22 pc96_23;
missjm96=0;

do i=1 to 16;
  if base[i] eq 1 and better[i] in (1,2) then pc[i]=better[i];
  else if base[i] eq 2 then pc[i]=3;
  else if base[i] eq 3 and worse[i] in (4,5) then pc[i]=worse[i];
  else pc[i]=.;
  if pc[i] eq . then missjm96=missjm96+1;
  end;

if missjm96 = 0  then
iqtot96=pc96_8+pc96_9+pc96_10+pc96_11+pc96_12+pc96_13+pc96_14+pc96_15+
        pc96_16+pc96_17+pc96_18+pc96_19+pc96_20+pc96_21+pc96_22+pc96_23;
  else iqtot96=.;

drop i;

avgiq96 = (iqtot96/16);

array behav [10] E1144--E1153;
array newpc  [10] PC96_24 PC96_25 PC96_26 PC96_27 PC96_28 PC96_29
        PC96_30 PC96_31 PC96_32 PC96_33;

do i=1 to 10;
  if 1 le behav[i] le 5 then newpc[i]=behav[i];
    else if behav[i] in (8,9,.) then newpc[i]=.;
  end;

drop i;

judge96 = .;
  if 1 le E1061 le 5 then judge96=E1061;
orgize96 = .;
  if 1 le E1066 le 5 then orgize96=E1066;
slfmem96=.;
  if 1 le E1161 le 5 then slfmem96=E1161;
pstmem96=.;
  if 1 le E1162 le 5 then pstmem96=E1162;
```

label immrec96 = 'Immediate Word Recall- HRS96'
    delrec96 = 'Delayed Word Recall - HRS96'
        totrec96 = 'Total Recall - HRS96'
        bwc20_96 = 'Backwards Count from 20 - HRS96'
        bwc86_96 = 'Backwards Count from 86 - HRS96'
        date96 = 'Dates (0-4) - HRS96'
        mo96 = 'Date: Month - HRS96'
        dy96 = 'Date: Day - HRS96'
        yr96 = 'Date: Year - HRS96'
        dw96 = 'Date: day of week - HRS96'
        scis96 = 'Scissors - HRS96'
        cact96 = 'Cactus - HRS96'
        pres96 = 'President - HRS96'
        vp96 = 'Vice President - HRS96'
        ser7_96 = 'Serial 7s - HRS96'
        vocab96 = 'Vocabulary Summary - HRS96'
        TICS96 = 'TICS Summary Var - HRS96'
        totcog96 = 'Total Cognition Summary - HRS96'
        MISSJM96='JORM IQCODE: NUMBER MISSING - HRS96'
        IQTOT96 = 'JORM IQCODE: TOTAL SCORE - HRS96'
        AVGIQ96 = 'JORM IQCODE: AVERAGE SCORE - HRS96';

HRS 1998

```
/* Immediate Recall */
immrec98=.;
array irec[11] F1491M1 - F1491M11;
if F1491M1 ne . or F1491M1 ne 95 or F1491M1 ne 97
or F1491M1 ne 99 then do;
  immrec98 = 0;
  do i = 1 to 11;
    if 1 <= irec[i] <= 40 then immrec98 + 1;
  end;
end;

if F1491M1 = . or F1491M1 = 95 or F1491M1 = 97 or F1491M1 = 99
then immrec98 = .;

/* Delayed Recall */
array drec[11] F1640M1 - F1640M11;
if F1640M1 ne . or F1640M1 ne 95 or F1640M1 ne 97
or F1640M1 ne 99 then do;
  delrec98 = 0;
  do i = 1 to 11;
    if 1 <= drec[i] <= 40 then delrec98 + 1;
  end;
end;
```

```
if F1640M1 = . or F1640M1 = 95 or F1640M1 = 97 or F1640M1 = 99
then delrec98 = .;

/* Total Recall */
if immrec98=. or delrec98=. then totrec98=.;
  else totrec98=immrec98+delrec98;

/* Serial 7s */
if F1631 eq 93 then ser7_98=1;
  else if F1631 ne 93 and F1631 ne . then ser7_98=0;
if (F1631 - F1632) eq 7 then ser7_98 + 1;
if (F1632 - F1633) eq 7 then ser7_98 + 1;
if (F1633 - F1634) eq 7 then ser7_98 + 1;
if (F1634 - F1635) eq 7 then ser7_98 + 1;
if F1631=999 or F1631=. then ser7_98 =.;

/*Backwards Count - 20 & 86*/
/*No 9's or other extraneous codes used in this wave*/
if F1558 eq 1 then bwc20_98=1;
  else if F1535 eq 1 then bwc20_98=2;
    else if F1535 eq . or F1535 eq 9 then bwc20_98=.;
          else bwc20_98=0;

if F1617 eq 1 then bwc86_98=1;
  else if F1594 eq 1 then bwc86_98=2;
    else if F1594 eq . or F1594 eq 9 then bwc86_98=.;
       else bwc86_98=0;

/* Date Naming, Word Recognition, & Knowledge Questions */
array OLD [8] F1645 F1646 F1647 F1648 F1649 F1650 F1651 F1652;

array NEW [8] mo98 dy98 yr98 dw98 scis98 cact98
    pres98 vp98;

do i=1 to 8;
  if OLD[i] eq 5 or OLD[i] eq 7 or OLD[i] eq 8 then NEW[i]=0;
  else if OLD[i] eq 9 or OLD[i] eq . then NEW[i]=.;
  else if OLD[i] eq 1 then NEW[i]=1;
  end;

if mo98 ne . or dy98 ne . or yr98 ne . or dw98 ne .
  then date98 = (mo98 + dy98 + yr98 + dw98);
    else date98=.;

Title 'HRS 98 - Cognition Measures';
/*recoding self-rated memory Question; DK & RF = missing*/
if F1479=8 or F1479=9 or F1479=. then F1479_R=.;
  else F1479_R=F1479;
/*recoding memory compared to last interview Question; DK & RF = missing*/
```

```
if F1480=8 or F1480=9 or F1480=. then F1480_R=.;
  else F1480_R=F1480;

/* TICS Summary Variable */
TICS98 = (mo98 + dy98 + yr98 + dw98 + scis98 + cact98
     + pres98 + vp98 + bwc20_98);
if mo98 =. or dy98=. or yr98=. or dw98=. or scis98=.
  or cact98=. or pres98=. or vp98=. or bwc20_98=. then TICS98=.;

/* Total Cognition Summary Variable */
Totcog98= TICS98 + immrec98 + delrec98 + ser7_98;
if TICS98=. or immrec98=. or delrec98=. or ser7_98=. then Totcog98=.;

/* Jorm IQCODE Scoring */
array base [16] F1389 F1394 F1399 F1404 F1409 F1414 F1419 F1424 F1429 F1434
        F1439 F1444 F1448 F1451 F1454 F1457;
array better [16] F1390 F1395 F1400 F1405 F1410 F1415 F1420 F1425 F1430 F1435
        F1440 F1445 f1449 F1452 F1455 F1458;
array worse [16] F1391 F1396 F1401 F1406 F1411 F1416 F1421 F1426 F1431 F1436
        F1441 F1446 f1450 F1453 F1456 F1459;
array pc [16] pc98_8 pc98_9 pc98_10 pc98_11 pc98_12 pc98_13 pc98_14 pc98_15
        pc98_16 pc98_17 pc98_18 pc98_19 pc98_20 pc98_21 pc98_22 pc98_23;

missjm98=0;

do i=1 to 16;
  if base[i] eq 1 and better[i] in (1,2) then pc[i]=better[i];
  else if base[i] eq 2 then pc[i]=3;
  else if base[i] eq 3 and worse[i] in (4,5) then pc[i]=worse[i];
  else pc[i]=.;
  if pc[i] eq . then missjm98=missjm98+1;
  end;

if missjm98 = 0 then
iqtot98=pc98_8+pc98_9+pc98_10+pc98_11+pc98_12+pc98_13+pc98_14+pc98_15+
        pc98_16+pc98_17+pc98_18+pc98_19+pc98_20+pc98_21+pc98_22+pc98_23;
  else iqtot98=.;

drop i;

avgiq98 = (iqtot98/16);

array behav [10] F1461--F1470;
array newpc  [10] PC98_24 PC98_25 PC98_26 PC98_27 PC98_28 PC98_29
        PC98_30 PC98_31 PC98_32 PC98_33;
do i=1 to 10;
  if 1 le behav[i] le 5 then newpc[i]=behav[i];
    else if behav[i] in (8,9,.) then newpc[i]=.;
  end;
```

```
drop i;

judge98 = .;
  if 1 le F1378 le 5 then judge98=F1378;
orgize98 = .;
  if 1 le F1383 le 5 then orgize98=F1383;
slfmem98=.;
  if 1 le F1479 le 5 then slfmem98=F1479;
pstmem98=.;
  if 1 le F1480 le 5 then pstmem98=F1480;


label    immrec98 = 'Immediate Word Recall- HRS98'
         delrec98 = 'Delayed Word Recall - HRS98'
          totrec98 = 'Total Recall - HRS98'
          bwc20_98 = 'Backwards Count from 20 - HRS98'
          bwc86_98 = 'Backwards Count from 86 - HRS98'
          date98 = 'Dates (0-4) - HRS98'
          mo98 = 'Date: Month - HRS98'
          dy98 = 'Date: Day - HRS98'
          yr98 = 'Date: Year - HRS98'
          dw98 = 'Date: day of week - HRS98'
          scis98 = 'Scissors - HRS98'
          cact98 = 'Cactus - HRS98'
          pres98 = 'President - HRS98'
          vp98 = 'Vice President - HRS98'
          ser7_98 = 'Serial 7s - HRS98'
          TICS98 = 'TICS Summary Var - HRS98'
          totcog98 = 'Total Cognition Summary - HRS98'
          Pstmem98 = 'Memory compared to past HRS98'
          Slfmem98 = 'Self-rated memory HRS98'
         MISSJM98='JORM IQCODE: NUMBER MISSING - HRS98'
         IQTOT98 = 'JORM IQCODE: TOTAL SCORE - HRS98'
         AVGIQ98 = 'JORM IQCODE: AVERAGE SCORE - HRS98'
         judge98 = 'Judgements/decison rating - HRS98'
         orgize98= 'Organize daily activities rating - HRS98';
```

HRS 2000

```
/* Immediate Recall */
immrec00=.;
array irec[11] G1666M1 - G1666M11;
if G1666M1 ne . or G1666M1 ne 95 or G1666M1 ne 97
or G1666M1 ne 99 then do;
   IMMREC00= 0;
   do i = 1 to 11;
     if 1 <= irec[i] <= 40 then immrec00 + 1;
   end;
end;

if G1666M1 = . or G1666M1 = 95 or G1666M1 = 97 or G1666M1 = 99
then immrec00 = .;

/* Delayed Recall */
array drec[11] G1815M1 - G1815M11;
if G1815M1 ne . or G1815M1 ne 95 or G1815M1 ne 97
or G1815M1 ne 99 then do;
   delrec00 = 0;
   do i = 1 to 11;
     if 1 <= drec[i] <= 40 then delrec00 + 1;
   end;
end;
if G1815M1 = . or G1815M1 = 95 or G1815M1 = 97 or G1815M1 = 99
then delrec00 = .;

/* Total Recall */
if immrec00=. or delrec00=. then totrec00=.;
   else totrec00=immrec00+delrec00;

/* Serial 7s */
if G1806 eq 93 then ser7_00=1;
   else if G1806 ne 93 and G1806 ne . then ser7_00=0;
if (G1806 - G1807) eq 7 then ser7_00 + 1;
if (G1807 - G1808) eq 7 then ser7_00 + 1;
if (G1808 - G1809) eq 7 then ser7_00 + 1;
if (G1809 - G1810) eq 7 then ser7_00 + 1;
if G1806=999 or G1806=. then ser7_00 =.;

/*Backwards Count - 20 & 86*/
/*No 9's or other extraneous codes used in this wave*/
if G1733 eq 1 then bwc20_00=1;
   else if G1710 eq 1 then bwc20_00=2;
     else if G1710 eq . or G1710 eq 9 then bwc20_00=.;
          else bwc20_00=0;

if G1792 eq 1 then bwc86_00=1;
```

```
      else if G1769 eq 1 then bwc86_00=2;
        else if G1769 eq . or G1769 eq 9 then bwc86_00=.;
          else bwc86_00=0;


/* Date Naming, Word Recognition, & Knowledge Questions */
array OLD [8] G1820 G1821 G1822 G1823 G1824 G1825 G1826 G1827;

array NEW [8] mo00 dy00 yr00 dw00 scis00 cact00
    pres00 vp00;

do i=1 to 8;
   if OLD[i] eq 5 or OLD[i] eq 7 or OLD[i] eq 8 then NEW[i]=0;
   else if OLD[i] eq 9 or OLD[i] eq . then NEW[i]=.;
   else if OLD[i] eq 1 then NEW[i]=1;
   end;
drop i;

date00 = (mo00 + dy00 + yr00 + dw00);



Title 'HRS 00 - Cognition Measures';
/*recoding self-rated memory Question; DK & RF = missing*/
slfmem00=.;
if G1654=8 or G1654=9 or G1654=. then slfmem00=.;
   else slfmem00=G1654;
/*recoding memory compared to last interview Question; DK & RF = missing*/
if G1655=8 or G1655=9 or G1655=. then pstmem00=.;
  else pstmem00=G1655;

/* TICS Summary Variable */
TICS00 = (mo00 + dy00 + yr00 + dw00 + scis00 + cact00
    + pres00 + vp00 + bwc20_00);

/* Total Cognition Summary Variable */
Totcog00= TICS00 + immrec00 + delrec00 + ser7_00;


array voc1 [5] G1832_1 G1835_1 G1838_1 G1841_1 G1844_1;
array voc2 [5] G1832_2 G1835_2 G1838_2 G1841_2 G1844_2;
array vcomb [5] voc1_00 voc2_00 voc3_00 voc4_00 voc5_00;

misvoc00 = 0;
do i=1 to 5;
  if (voc1[i] eq 1) or (voc2[i] eq 1) then vcomb[i] = 0;
  else if (voc1[i] eq 2) or (voc2[i] eq 2) then vcomb[i] = 1;
  else if (voc1[i] eq 3) or (voc2[i] eq 3) then vcomb[i] = 2;
  else vcomb[i]=.;
  if vcomb[i] eq . then misvoc00=misvoc00+1;
  end;
drop i;
```

```
vlist00=.;
if G1832_1 in (1,2,3) then vlist00=1;
else if G1832_2 in (1,2,3) then vlist00=2;
else vlist00=0;

if misvoc00 = 0 then vocab00 = voc1_00 + voc2_00 + voc3_00 + voc4_00 + voc5_00;
  else vocab00=.;

/* Recoding basic Proxy Cognition Measures */

**Rate memory - same variable as self Rs but this asked of proxy R's;
judge00=.;
orgize00=.;

if G514 ne 1 then do;
  if G1527 in (8,9,.) then slfmem00=.;
  else slfmem00=G1527;

  if G1528 in (8,9,.) then pstmem00=.;
  else pstmem00=G1528;

  if G1532 in (8,9,.) then judge00=.;
  else judge00=G1532;

  if G1537 in (8,9,.) then orgize00=.;
  else orgize00=G1537;
end;

/*  Jorm IQCODE Scoring  */

array base [16] G1543 G1548 G1553 G1558 G1563 G1568 G1573 G1578 G1583 G1588
        G1593 G1598 G1602 G1605 G1608 G1611;
array better [16] G1544 G1549 G1554 G1559 G1564 G1569 G1574 G1579 G1584 G1589
        G1594 G1599 G1603 G1606 G1609 G1612;
array worse [16] G1545 G1550 G1555 G1560 G1565 G1570 G1575 G1580 G1585 G1590
        G1595 G1600 G1604 G1607 G1610 G1613;
array pc [16] pc00_8 pc00_9 pc00_10 pc00_11 pc00_12 pc00_13 pc00_14 pc00_15
        pc00_16 pc00_17 pc00_18 pc00_19 pc00_20 pc00_21 pc00_22 pc00_23;
```

```
missjm00=0;

do i=1 to 16;
   if base[i] eq 1 and better[i] in (1,2) then pc[i]=better[i];
   else if base[i] eq 2 then pc[i]=3;
   else if base[i] eq 3 and worse[i] in (4,5) then pc[i]=worse[i];
   else pc[i]=.;
   if pc[i] eq . then missjm00=missjm00+1;
   end;

if missjm00 = 0 then
iqtot00=pc00_8+pc00_9+pc00_10+pc00_11+pc00_12+pc00_13+pc00_14+pc00_15+
        pc00_16+pc00_17+pc00_18+pc00_19+pc00_20+pc00_21+pc00_22+pc00_23;
  else iqtot00=.;

drop i;

avgiq00 = (iqtot00/16);

array behav [10] G1615 G1616 G1617 G1618 G1619 G1620 G1621 G1622 G1623 G1624;
array newpc  [10] pc00_24 pc00_25 pc00_26 pc00_27 pc00_28 pc00_29
        pc00_30 pc00_31 pc00_32 pc00_33;

do i=1 to 10;
  if behav[i] eq 1 then newpc[i]=behav[i];
    else if behav[i] eq 2 then newpc[i]=behav[i];
    else if behav[i] eq 3 then newpc[i]=behav[i];
        else if behav [i] eq 5 then newpc[i]=behav[i];
    else if behav[i] eq 8 then newpc[i]=.;
        else if behav[i] eq 9 or behav[i] eq . then newpc[i]=.;
  end;
drop i;
```

HRS 2002

```
/* Immediate & Delayed Word Recall */
immrec02=.;
delrec02=.;
if HD103 eq 9 then do;
 immrec02 = .;
 delrec02 = .;
end;
else do;
 immrec02 = HD174;
 delrec02 = HD184;
end;


/* Total Recall */
```

```
if immrec02=. or delrec02=. then totrec02=.;
  else totrec02=immrec02+delrec02;

/* Serial 7s */
ser7_02 = 0;
if hd142 eq 93 then ser7_02=1;
  else if hd142 ne 93 and hd142 ne . then ser7_02=0;
if (hd142 - hd143) eq 7 then ser7_02 + 1;
if (hd143 - hd144) eq 7 then ser7_02 + 1;
if (hd144 - hd145) eq 7 then ser7_02 + 1;
if (hd145 - hd146) eq 7 then ser7_02 + 1;
if hd142=999 then ser7_02=.;


/*Backwards Count - 20 & 86*/
if HD129 eq 1 then bwc20_02=1;
  else if HD124 eq 1 then bwc20_02=2;
    else if HD124 eq . or HD124 eq 9 then bwc20_02=.;
        else bwc20_02=0;

if HD139 eq 1 then bwc86_02=1;
  else if HD134 eq 1 then bwc86_02=2;
    else if HD134 eq . or HD134 eq 9 then bwc86_02=.;
      else bwc86_02=0;


/* Date Naming, Word Recognition, & Knowledge Questions */
array OLD [8] HD151 HD152 HD153 HD154 HD155 HD156 HD157 HD158;
array NEW [8] mo02 dy02 yr02 dw02 scis02 cact02
    pres02 vp02;

do i=1 to 8;
  if OLD[i] eq 5 or OLD[i] eq 7 or OLD[i] eq 8 then NEW[i]=0;
  else if OLD[i] eq 9 or OLD[i] eq . then NEW[i]=.;
  else if OLD[i] eq 1 then NEW[i]=1;
  end;
drop i;

date02 = (mo02 + dy02 + yr02 + dw02);

/* TICS Summary Variable */
TICS02 = (mo02 + dy02 + yr02 + dw02 + scis02 + cact02
    + pres02 + vp02 + bwc20_02);

/* Total Cognition Summary Variable */
Totcog02= TICS02 + immrec02 + delrec02 + ser7_02;

Title 'HRS 02 - Cognition Measures';
/*recoding self-rated memory Question; DK & RF = missing*/
```

```sas
slfmem02=.;
if HD101=8 or HD101=9 or HD101=. then slfmem02=.;
  else slfmem02=HD101;

if HD101 eq . then do;
  if HD101=8 or HD101=9 or HD101=. then slfmem02=.;
   else slfmem02=HD101;
end;

/*recoding memory compared to last interview Question; DK & RF = missing*/
if HD102=8 or HD102=9 or HD102=. then pstmem02=.;
  else pstmem02=HD102;

/*WAIS Vocabulary Items*/
vocab02 = 0;
array oldvoc [5] hd161 hd163 hd165 hd167 hd169;
array newvoc [5] voc1_02 voc2_02 voc3_02 voc4_02 voc5_02;

misvoc02=0;

do j = 1 to 5;
  newvoc[j]=oldvoc[j];
  if newvoc[j]=9 then newvoc[j]=.;
  if newvoc[j] in (1 2) then vocab02 = vocab02 + oldvoc[j];
  else if newvoc[j] eq . then misvoc02 = misvoc02+1;
  end;
drop j;
if misvoc02 gt 0 then vocab02=.;

/* Recoding basic Proxy Cognition Measures */
judge02=.;
orgize02=.;

if HPROXY eq 1 then do;
  if HD501 in (8,9,.) then HD501=.;

  if HD502 in (8,9,.) then HD502=.;

  if HD503 in (8,9,.) then judge02=.;
  else judge02=HD503;

  if HD504 in (8,9,.) then orgize02=.;
  else orgize02=HD504;
end;

/*  Jorm IQCODE Scoring  */
array base [16] HD506 HD509 HD512 HD515 HD518 HD521 HD524 HD527 HD530 HD533
          HD536 HD539 HD542 HD545 HD548 HD551;
array better [16] HD507 HD510 HD513 HD516 HD519 HD522 HD525 HD528 HD531 HD534
```

```
               HD537 HD540 HD543 HD546 HD549 HD552;
array worse [16] HD508 HD511 HD514 HD517 HD520 HD523 HD526 HD529 HD532 HD535
           HD538 HD541 HD544 HD547 HD550 HD553;
array pc [16] pc02_8 pc02_9 pc02_10 pc02_11 pc02_12 pc02_13 pc02_14 pc02_15
           pc02_16 pc02_17 pc02_18 pc02_19 pc02_20 pc02_21 pc02_22 pc02_23;

missjm02=0;

do i=1 to 16;
   if base[i] eq 1 and better[i] in (1,2) then pc[i]=better[i];
   else if base[i] eq 2 then pc[i]=3;
   else if base[i] eq 3 and worse[i] in (4,5) then pc[i]=worse[i];
   else pc[i]=.;
   if pc[i] eq . then missjm02=missjm02+1;
   end;

if missjm02 = 0 then
iqtot02=pc02_8+pc02_9+pc02_10+pc02_11+pc02_12+pc02_13+pc02_14+pc02_15+
           pc02_16+pc02_17+pc02_18+pc02_19+pc02_20+pc02_21+pc02_22+pc02_23;
   else iqtot02=.;

avgiq02 = (iqtot02/16);

array behav [10] HD554 HD555 HD556 HD557 HD558 HD559 HD560 HD561 HD562 HD563;
array newpc [10] pc02_24 pc02_25 pc02_26 pc02_27 pc02_28 pc02_29
           pc02_30 pc02_31 pc02_32 pc02_33;

do i=1 to 10;
   if behav[i] eq 1 then newpc[i]=behav[i];
     else if behav[i] eq 2 then newpc[i]=behav[i];
     else if behav[i] eq 3 then newpc[i]=behav[i];
          else if behav [i] eq 5 then newpc[i]=behav[i];
     else if behav[i] eq 8 then newpc[i]=.;
          else if behav[i] eq 9 or behav[i] eq . then newpc[i]=.;
   end;
drop i;

label    immrec02 = 'Immediate Word Recall- HRS02'
         delrec02 = 'Delayed Word Recall - HRS02'
         totrec02 = 'Total Recall - HRS02'
         bwc20_02 = 'Backwards Count from 20 - HRS02'
         bwc86_02 = 'Backwards Count from 86 - HRS02'
         date02 = 'Dates (0-4) - HRS02'
         mo02 = 'Date: Month - HRS02'
         dy02 = 'Date: Day - HRS02'
         yr02 = 'Date: Year - HRS02'
         dw02 = 'Date: day of week - HRS02'
         scis02 = 'Scissors - HRS02'
         cact02 = 'Cactus - HRS02'
```

pres02 = 'President - HRS02'
vp02 = 'Vice President - HRS02'
ser7_02 = 'Serial 7s - HRS02'
TICS02 = 'TICS Summary Var - HRS02'
totcog02 = 'Total Cognition Summary - HRS02'
Pstmem02 = 'Memory compared to past HRS020'
Slfmem02 = 'Self-rated memory HRS02'
voc1_02 = 'Vocab Word 1 HRS02'
voc2_02 = 'Vocab Word 2 HRS02'
voc3_02 = 'Vocab Word 3 HRS02'
voc4_02 = 'Vocab Word 4 HRS02'
voc5_02 = 'Vocab Word 5 HRS02'
vocab02 = 'Vocab Sum Score HRS02'
misvoc02 = 'WAIS Vocab Items - Nmiss HRS02'
MISSJM02='JORM IQCODE: NUMBER MISSING - HRS02'
IQTOT02 = 'JORM IQCODE: TOTAL SCORE - HRS02'
AVGIQ02 = 'JORM IQCODE: AVERAGE SCORE - HRS02'
judge02 = 'Judgements/decison rating - HRS02'
orgize02= 'Organize daily activities rating - HRS02';