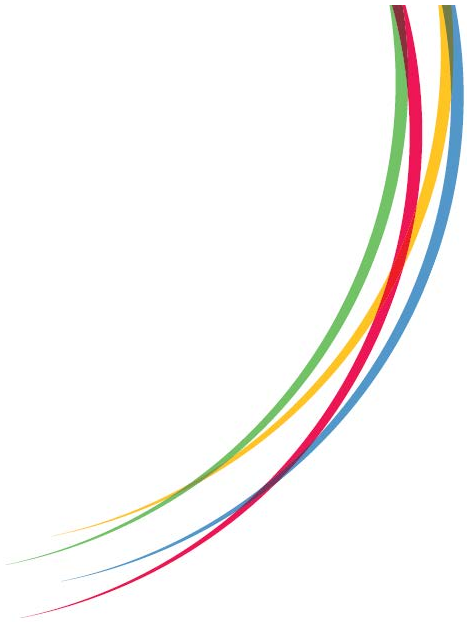


UNDERSTANDING SOCIETY: UK HOUSEHOLD LONGITUDINAL STUDY: COGNITIVE ABILITY MEASURES

Prepared by
Stephanie McFall

Institute for Social and Economic Research
University of Essex
Colchester
Essex

Version 1.1, October 2013

Understanding Society
THE UK HOUSEHOLD LONGITUDINAL STUDY

E·S·R·C
ECONOMIC & SOCIAL RESEARCH COUNCIL

CONTENTS

OVERVIEW OF STUDY

Understanding Society -- the UK Household Longitudinal Study (UKHLS) --is a large longitudinal survey of England, Scotland, Wales and Northern Ireland. Households recruited at the first round of data collection are visited one year later to collect information on changes to their household and individual circumstances. Interviews are carried out face-to-face in respondents' homes by trained interviewers. The current data release is of Wave 3 data collected between January 2011 and April 2013.

The overall purpose of *Understanding Society* is to provide high quality longitudinal data about topics such as health, work, education, income, family, and social life to help understand the long term effects of social and economic change, as well as policy interventions designed to impact upon the general well-being of the UK population. The cognitive ability measures will contribute to this research agenda as described below.

This guide to cognitive ability measures describes concepts, questions and measures for the cognitive ability modules included in Wave 3 of the main and Innovation Panel surveys. It extends information available in quesionnaires and online data documentation. Researchers making use of the cognitive ability data should also consult the User Manual for the overall study to learn about data collection processes, sample design, response outcomes, weighting, and imputation of income variables. The User Manual for the overall study also has information about file structure and code for common data management tasks (McFall, 2013).

BACKGROUND

The Economic and Social Research Council (ESRC) with resources from the Large Facilities Capital Fund of the Department for Business, Innovation, and Skills funded additional time for measurement of cognitive ability and other relatively stable psycholgical variables. This project also financed the collection of biomeasures and biological samples (McFall, Petersen, Kaminska, & Lynn, 2013). The non-cognitive variables, e.g., Big Five personality measure, are documented in standard ways (see User Manual for overall study and online data documentation https://www.understandingsociety.ac.uk/documentation/mainstage/dataset-documentation).

Various longitudinal studies have included measures of cognitive ability. They have been featured in coordinated studies of ageing in multiple countries, including the English Longitudinal Study on Ageing (ELSA) (Banks, Breeze, Lessof, & Nazroo, 2006), the U.S. Health and Retirement Study (HRS) (Crimmins, Kim, Langa & Weir 2011), the Survey of Health and Retirement Europe, multiple countries in Europe (SHARE) (Borsch-Supan, 2013), and others. In the UK, several of the birth cohort studies have had cognitive measures for children or older adults, e.g. National Study of Health and Development (Kuh et al, 2011; Bynner & Wadsworth, n.d.).

The cognitive ability measures for *Understanding Society* were conducted with adults of all ages, beginning with age 16. Thus the study provides access to multiple measures of cognitive ability for a population of all adult ages. The diverse content of *Understanding Society* will support the assessment of the relationships of

cognitive ability and social, health, economic and psychological factors. For the subset of persons who participated in the health assessment and gave biological samples (McFall et al, 2013), there is the potential to examine the relationship of cognitive abiity with objective health indicators and to genetic data.

The measures were selected to be

- Reliable and valid
- Represent multiple dimensions of cognitive ability
- Brief
- Suitable for administration via other modes
- Have been used in other surveys

Not surprisingly cognitive ability or cognitive function is a multidimensional construct. There is general agreement about variation at three levels: a general cognitive ability (g factor), broad domains and test specific variation in performance. There is less agreement about the domains or the underlying source of observed differences (Deary, 2012). The domains identified by Carroll (1993) were fluid, crystallized, fluency, memory, perceptual speed and visualization. As noted, it is desirable to have measures addressing multiple domains.

The desire to have measures suitable for administration via different modes responds to multiple trends in survey research. For example, there is great interest in having *Understanding Society* employ multiple modes of data collection in order to reduce costs and suit the mode preferences of some participants. At the time of selection of the cognitive measures, the alternative mode under consideration was telephone interviewing. Recently, *Understanding Society* has been experimenting with mixed mode approaches that make use of web, telephone, and personal interviews (Jäckle, Lynn, & Burton, 2013). Wave 3 did not employ a mixed mode strategy except for minor variants, which are described below.

Prior to implementation of the measures we conducted cognitive interviews to identify problems with the cognitive measures. The situation of those whose primary language is not English was also examined. A working paper describes the findings of this qualitative study and the resulting changes recommended (Gray, D'Ardenne, Balarjan & Uhris, 2011).

IMPORTANCE OF COGNITIVE ABILITY

Sociologists and economists have long been interested in the role of cognitive ability in educational and occupational attainment and other related labour market outcomes that shape the life course (Richards, Sacker & Deary, 2007; Farkas, 2004; Heckman, Stixrud & Urzua, 2006). Education has a particularly strong association with cognitive function (Alley, Suthers & Crimmins, 2007). Researchers have viewed cognitive ability as both a precursor and an outcome. There is also interest in the relative impact of cognitive and non-cognitive skills.

There is great interest in age-related differences in cognitive function, both for practical reasons and for what they may mean for changes in brain and neurological structure and function (Deary, 2012; Park & Schwarz, 2012). Many aspects of cognition decline with age, beginning in young adulthood, eg, speed of processing, memory, working memory (Salthouse, 2010). Knowledge related aspects of

cognition or crystallized intelligence improve over much of life, only declining about age 60 (Schaie, 2005; Salthouse, 2010). These patterns have been found in both cross-sectional and longitudinal studies, though differences are often smaller in longitudinal studies, possibly related to practice effects (Schaie, 2005; Salthouse, 2012). Some address these issues in a life course framework (Richards & Hatch, 2011).

There have been several theoretical explanations for what produces age related differences in cognitive ability. These include declines in processing speed, declines in executive control influencing working memory and other cognitive dimensions, and the interaction of sensory and cognitive processes. There is interest in how changes in performance are related to changes in brain structures, neural pathways and neuro-receptors. Compensatory mechanisms may balance age related cognitive declines as expressed in daily life (Park & Reuter-Lorenz, 2009).

Cognitive ability is frequently examined in relation to health either as a predictor or outcome (Deary, 2012; Gottfredson, 2004). Lower cognitive ability, measured in childhood or adulthood, has been linked to mortality and morbidity (Batty et al, 2009). Associations with health conditions are stronger with respect to psychiatric than physical conditions. Within physical health outcomes, associations have been more strong with cardiovascular conditions and a wide variety of risk factors for cardiovascular disease (Deary, 2012).

There is greater evidence for hereditary influences on cognitive ability than for the pinpointing of many specific influential genes. The level of influence has been found to vary with age and potentially other environmental factors (Deary, 2012).

The range of topics and measurement domains in Understanding Society should support a wide range of multidisciplinary research.

DATA COLLECTION ISSUES

ELIGIBILITY

The cognitive ability module is part of the adult mainstage interview in Wave 3. The sample components are the new general population component, the ethnic minority boost, and the former BHPS participants. Components can be identified with **c_hhorig.**

All participants aged 16 or older with full interviews were eligible. Those with a proxy interview were excluded. Most interviews were conducted face to face. However, a small segment of the BHPS sample component is interviewed by telephone. In addition, in the second year of Wave 3 data collection, a process of telephone recruitment and interview was initiated to encourage the interview of who had been difficult to contact and interview. Colloquially, we referred to this phase of data collection as ‘telephone mop-up’. The mode of interview can be identified with the variable **c_indmode.**

LANGUAGE

As with all questionnaire modules, the cognitive ability module was translated into nine languages: Arabic, Bengali, Cantonese, Gujarati, Punjabi in Gurmukhi or Urdu script, Somali, Urdu and Welsh. The indicator for whether the language of interview was English is **c_liceng** and for the specific language is **c_ivlitrans_all**. The

interviewer provides a rating of language ability is in **c_clangab**. In addition, there are variables for refusal or stopping of individual tests because of language problems.

INTERVIEW INSTRUCTIONS

The training stressed the importance of standardisation of procedures, that is, not deviating from the measurement process defined in the protocol, so that the measurements are accurate. The interviewer project instructions can be obtained in the fieldwork documents section: https://www.understandingsociety.ac.uk/documentation/mainstage/fieldwork-documents. (Wave 3)

Interviewers were also told to minimise disturbances and interruptions in administration of the cognitive ability module. If possible, interviewers were asked to confine the interview situation to the respondent only. Interviewers were instructed to limit their use of supportive feedback in this section. They could say things like 'keep going', but not tell the respondent how they were doing or say whether responses were correct or not. For the timed tests, the timing was done with the CAPI program.

For each test or task, interviewers recorded these auxiliary variables:

- Presence of others and whether they were household members
- Receipt of assistance
- Problems with the test, e.g., difficulty hearing, interruptions
- Use of aids, e.g., paper and pencil
- Reasons for refusal or stopping a test

In addition, interviewers recorded observations about the module as a whole:

- Language of interview (described above)
- Language proficiency (described above)
- Anxiety or distress related to the tasks (**c_cogdist**)

HOUSEHOLD CONTEXT AND TRAINING OR PRACTICE EFFECTS

It is harder to control the administration process within respondents' homes than in psychological laboratories, such that others may interrupt or assist. In addition, participants can learn from watching the interviews of other household members. Thus, their performance may be influenced by their own testing at an earlier wave or that of household members. These could be described as learning or practice effects.

For all tasks, interviewers recorded the presence and assistance of others so researchers can examine this potential influence if they wish. In addition, for the Number Series and Word Recall tests, we have randomised assignment to different word lists or number series problems.

LIST OF MEASURES IN WAVE 3 MAIN SURVEY

This section describes the cognitive ability measures from the Wave 3 main survey. In each section there is some brief background information for each measure. This is

followed by a description of measurement procedures. A section concludes with notes about derived variables or other issues in scoring. For more detail about the exact question wording, skip patterns, and response coding, refer to the questionnaires https://www.understandingsociety.ac.uk/documentation/mainstage/questionnaires. The online documentation system provides frequency information. See https://www.understandingsociety.ac.uk/documentation/mainstage.

There are multiple derived variables to simplify the use of the measures. Their variables begin with the characters "cg" and have a suffix "_dv". All the cognitive ability measures appear in the datafile C_INDRESP.

PERCEIVED OR SELF-RATED MEMORY

One question was asked about the respondent's perception of his or her memory. We included this measure because it provides information about subjective memory abilities, which may capture aspects of performance not provided by objective testing. Some view self-rated memory as related to metacognition.

Generally speaking, self-rated memory decreases with age. However, not all studies have found subjective or perceived memory to be related to objective cognitive ability.[21]

A number of surveys have included this measure including ELSA, HRS, and the Irish Longitudinal Study on Ageing (TILDA) (Huppert, Gardener & McWilliams, 2006; Ofstedal, Fisher & Herzog, 2005; Savva, Maty, Setti, & Feeney, 2013).

PROCEDURES

The interviewer introduces the module: *Part of this study is concerned with people's memory and the ability to think about things in everyday life. In the next section of the interview, we will do some memory and concentration tasks. Some may seem easier than others. Please just do the best you can on all of them.*

First, how would you rate your memory at the present time? Would you say it is excellent, very good, good, fair or poor? The response categories are as listed, with the addition of don't know and refused.

NOTES

Two derived variables have been produced for this measure. The full item is **c_cgsrmem_dv** and a dichotomouse variable distinguishing those who rate their memory as fair or poor vs. those with a more positive view of their memory is **c_cgsrmem2_dv**.

MEMORY

The immediate and delayed word recall tasks assess episodic memory, that is memory tied to a specific event or episode. Recall tests are negatively associated with age (Schaie, 2005; Salthouse, 2010). These tasks may involve retrieval processing resources that are less available in older persons. In addition to age, there are associations with such social and economic factors as education and social class.

Multiple studies have included this measure, e.g., HRS, ELSA, NSHD, and SHARE (Ofstedal, et al, 2005; Huppert, et al, 2006; Richards, Shipley, Fuhrer & Wadsworth, 2004; Borsch-Supan, et al, 2013; Hurst, Stafford, Cooper, Hardy, Richards & Kuh, 2013). The Midlife in the United States study (MIDUS), a nationally representative study of US persons age 20-74 has a similar measure (Lachman, Agrigoroaei, Murphy, & Tun, 2010).

PROCEDURES

For this task, the computer reads a list of 10 words to standardise the presentation and speed of the word list. The interviewer checks if the respondent can hear the computer playing a short test message. If the voice cannot be heard the interviewer checks again following adjustment of the volume. If the respondent still cannot hear the computer's voice, the interviewer reads the words at a slow steady rate of about one word every two seconds. The list of words is not repeated. No aids are allowed for the test.

Interviewer: *The computer will now read a set of 10 words. I would like you to remember as many as you can. We have purposely made the list long so it will be difficult for anyone to remember all the words. Most people remember just a few. Please listen carefully to the set of words as they cannot be repeated. When it has finished, I will ask you to recall aloud as many of the words as you can, in any order. Is this clear?*

Now please tell me the words you can remember. Respondents give the words in any order. The interviewer codes each correct response.

For the delayed word recall test, after the Number Series test (below), respondents were again asked to remember the words from the list. The interviewer codes each correct response.

We used the word lists develped for the HRS, as does ELSA. The different lists were given to members of the same household based on random assignment. The lists can also be varied in subsequent waves to reduce learning. Table 1 has the word lists.

Table 1. Word lists for Immediate and Delayed Word Recall tasks			
Word list 1	Word list 2	Word list 3	Word list 4
HOTEL	SKY	WOMAN	WATER
RIVER	OCEAN	ROCK	CHURCH
TREE	FLAG	BLOOD	DOCTOR
SKIN	DOLLAR	CORNER	PALACE
GOLD	WIFE	SHOES	FIRE
MARKET	MACHINE	LETTER	GARDEN
PAPER	HOME	GIRL	SEA
CHILD	EARTH	HOUSE	VILLAGE
KING	COLLEGE	VALLEY	BABY
BOOK	BUTTER	ENGINE	TABLE

NOTES

Two derived variables were created to assess the number correct in the immediate word recall task **c_cgwri_dv** and in the delayed word recall task **c_cgwrd_dv**. Variables for the presence of others during these tasks are **c_cgivwri1_dv** and **c_cgivwrd1_dv.** The variable **c_wrdrcl** shows which word list was used for an individual. The variable **c_ff_wrdrcl** shows the assigned patterns for members of the household.

SERIAL 7 SUBTRACTION

This test assesses working memory, or the short-term integration, processing, disposal and retrieval of information. Working memory is also important in complex cognitive tasks such as reading and problem solving.

This measure is included in the HRS. It is a component of screening instruments for cognitive impairment including the Mini Mental State Examination (Crum, Anthony, Bassett & Folstein, 1993) and the Cambridge Cognitive Examination (CAMCOG) of the MRC Cognitive Function and Ageing study (CFAS) (Huppert, Brayne, Gill, Paykel & Beardsall, 1995).

PROCEDURES

In this test, the respondent is asked to give the correct answer to a series of subtraction questions. Starting at 100, the interviewer asks the respondent to subtract 7. At the next question, the respondent is asked to subtract 7 again, and so on. There is a sequence of five subtractions. No materials or aids were allowed for this test.

Interviewer: '*Now let's try some subtraction of numbers. One hundred minus 7 equals what?'* [Interviewer records the number.] *'And take 7 away from that?'* [records number] *'And take 7 away from that.'* The respondent gives numeric answers for successive trials, five in all.

NOTES

The derived variable **c_cgs7cs_dv** is a summary measure with scores of 1 for each correct subtraction, that is, response is 7 less than the previous answer. The maximum score is 5. There is also a derived variable **c_cgs7ca** which requires correct answers for all the subtractions.

NUMBER SERIES

The number series is designed to assess fluid reasoning or the ability to use abstract thought to solve novel problems. It is typically assessed via logic puzzles. The measure was developed for the HRS (Fisher, McArdle, McCammon, Sonnega & Weir, 2013).

Adaptive testing was used to select a small number of items from a pool of items the Woodcock-Johnson tests of cognitive ability, which ranged in difficulty. Scale values were assigned using item response theory. The calculated scores represent the likely level of correct items if the respondent had been given all items on the original test. In adaptive testing the participants begins with a set of baseline items with assignment to subsequent items determined by the initial level of performance. Because of copyrighting restrictions the specific items are not shown in the documentation.

Generally, measures of fluid reasoning are negatively associated with age (Salthouse, 2010). This specific measure has not been widely used. Delavande, Willis and Rohwedder (2008) found that the number series score was strongly associted with a test of financial knowledge. However, the number series score was not associated with household wealth, possibly because of a small sample size (Smith, McArdle, & Willis, 2009).

PROCEDURES

Individuals are randomly assigned to Set 1 or Set 2 (of items) within households.

For this test, respondents use a pencil and paper to write down the number sequences as read by the interviewer. The number series consists of several numbers with a blank number in the series. The respondent will be asked which number goes in the blank.

The interviewer begins with a simple example so the respondent can see how the test works. For the example, the interviewer can tell the respondent if they give an incorrect response and inform them of the correct answer. If the respondent does not understand the instructions, or answered 'Don't know' in the example, a further example is worked through. If they answer incorrectly a second time, CAPI instructs the interviewer to inform them of the correct response and explain how the sequence works. If the respondent still does not understand, or seems confused, the interviewer codes this and moves on to the next task. However, if the respondent understands the task, the interviewer moved on to the number series.

In the test proper, the interviewer does not provide feedback about correct answers or the respondent's performance. If the respondent says they do not know the answer, this was coded as 'Don't know'. If the respondent is unable to do the test, for example because of severe speech or hearing problems, or because they do not understand the instructions, this was coded as 'Unable to do'. Prompts were not given after the number series was written down by the respondent. Based on the number of correct responses given in the initial items, the computer selects a further series for the respondent to answer.

NOTES

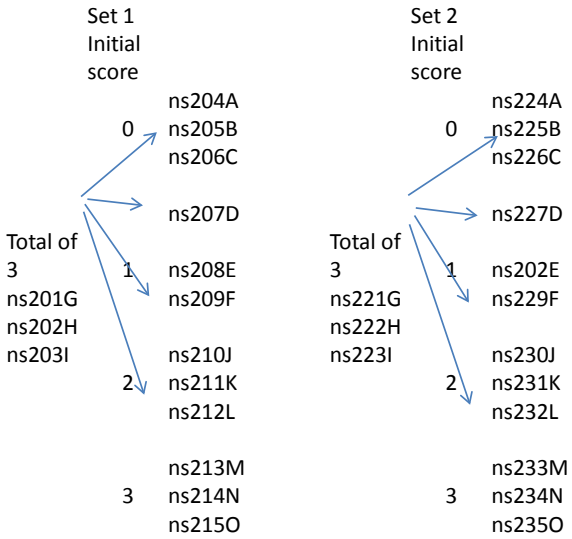
As noted, individuals are randomly assigned to Set 1 or 2. The variable controlling the assignment in households is **c_ff_nsran**. The variable showing the set assigned to individuals is **c_nsran**. Figure 1 shows the combination of items for the two sets for respondents with different levels of performance. We use the scoring presented by HRS. Within the normative sample, the mean is 500 and a change in the probability of getting an item right increases by twenty-five percent for every ten point change in the score.

There is an error in the first item of Set 2. The response alternative 'unable to do' was not properly programmed in the CAPI. Under the assumption that the proportion classified as 'unable to do' is similar to that in Set 1, about 4% of respondents were asked to complete items that they should have been asked to skip. We are conducting analyses to assess the effects of this error.

There are multiple derived variables. Currently they do not combine measures for randomly assigned Set 1 and Set 2. Table 2 summarizes the derived variables.

Table 2. Derived variables for the Number Series Task	
Description	**Variable names**
Number correct in initial 3 items	c_cgns1a_dv (random set 1) c_cgns2a_dv (random set 2)
Number correct in 2nd component (selection of items based on performance in initial 3 items)	c_cgns1b_dv (randomset 1) c_cgns2b_dv (random set 2)
Scoring based on HRS 2010	c_cgns1sc10_dv (random set 1) c_cgns2sc10_dv (random set 2)

Figure 1 Adaptive sequence as implemented in HRS & UKHLS
Randomly assigned to Set 1 or 2 with follow-up questions depending on score on initial list



VERBAL FLUENCY

This is a test of semantic or category fluency. It assesses some aspects of executive function in that the respondent must think of words in the category, monitor for duplicates and avoid responses that don't fit the rule--all within time limits. The test also requires self-initiated activity, organisation and abstraction (categorising animals into groups such as domestic, wild, birds, dogs), and mental flexibility (moving to a new category when no more animals come to mind from a previous category).

This test has been used in the ELSA (Llewellyn & Matthews, 2009), the German Socio-economic Panel Study (SOEP) (Lang, Weiss, Stocker & von Rosenbladt, 2007), the NSHD (Richards et al, 2004) and MIDUS (Lachman et al, 2010).

PROCEDURES

Interviewer: *Now, I would like you to name as many animals as you can. You have one-minute, so name them as quickly as possible. We will begin when you say the first animal. If you are unsure of anything please ask me now as I am unable to answer questions once the minute starts*

The interviewer instructions are to write down the actual words in the order in which they are produced. They are recorded in the Cognitive Ability Booklet.

With respect to scoring, extinct, imaginary or magical (e.g. dodo, unicorn, dragon) animals were scored as correct, but given names (e.g. Felix, Buster) were not. The assessment was timed by CAPI. The interviewer began the 60 second countdown on the computer as soon as the respondent said the first correct word.

NOTES

The derived variables are number correct (**c_cgvfc_dv**) and number incorrect (**c_cgvfw_dv**).

NUMERIC ABILITY

This tests skills in solving problems that might be encountered in everyday life. Numeracy is a measure of practical numerical knowledge. It has been found to be related to financial outcomes such as wealth (Smith, McArdle & Willis, 1009).The test was taken from ELSA and some portion of it has been used by the HRS and SHARE (Banks, O'Dea & Oldfield, 2010).

PROCEDURES

Interviewer: *Next I would like to ask you some questions to understand how people use numbers in everyday life.* If CATI, the interviewer added, *You might want to have a pencil and paper handy to help you answer the following items*

The measure of numeric ability asks respondents up to five questions that are graded in complexity. Table 2 displays the questions and how they are administered. Based on performance on the first three items, respondents can get additional more difficult items and a higher score or an additional more simple item. 'Don't know' was not a permitted response. There was a showcard with the text of the question. This can be seen in the fieldwork documents: https://www.understandingsociety.ac.uk/documentation/mainstage/fieldwork-documents.

Table 2. Sequence of items in number ability test and variable names

Initial 3 items and variable names	
In a sale, a shop is selling all items at half price. Before the sale, a sofa costs £300. How much will it cost in the sale? **c_nasofa**	
If the chance of getting a disease is 10 percent, how many people out of 1,000 (one thousand) would be expected to get the disease? **c_nadisease**	
A second hand car dealer is selling a car for £6,000. This is two thirds of what it cost new. How much did the car cost new? **c_nacar**	
Sequence of items based on initial performance and variable names	
If initial 3 items not all correct, ask one additional item	**If initial 3 items all correct, there is an additional 1-2 items depending on performance on the 4th item.**
If you buy a drink for 85 pence and pay with a one pound coin, how much change should you get back? **c_nadrink**.	If 5 people all have the winning numbers in the lottery and the prize is £2 million, how much will each of them get? (**c_nalottery**)
	Let's say you have £200 in a savings account. The account earns ten percent interest each year. How much would you have in the account at the end of two years? (**c_nainterest**)
Simple score: 0 to 3	Simple score 3 to 5

NOTES

We have computed a derived variable **c_cgna_dv**, a simple count of number of correct items.

COGNITIVE MEASURES IN INNOVATION PANEL

The purpose of the Innovation Panel is to test methodological questions relevant to Understanding Society and other longitudinal surveys. To answer survey questions, the respondent must comprehend the question, searchand retrieve information from memory, make a judgement using the response categories and report the answer. Cognitive ability influences the steps in the process and is a mediating variable in several areas of survey research methodology. Consequently, three cognitive measures were included in Wave 3 of the Innovation Panel to support the programme of methodological research.

The Innovation Panel is similar to the main stage survey in design and data collection procedures. Respondents were asked to consent to the audio recording of the cognitive function module. Interviewers coded the presence and identity of others present during the module. They also coded the use of aids for the Serial 7 subtraction task. The tasks are timed in the CAPI program. More information about the Innovation Panel can be found on the study website https://www.understandingsociety.ac.uk/documentation/innovation-panel. Data from the Innovation Panel can be obtained from the UK Data Service http://discover.ukdataservice.ac.uk/catalogue?sn=6849.

All the cognitive ability measures are in the file C_INDRESP_IP.

PROSPECTIVE MEMORY

Prospective memory is remembering to do something. This ability is clearly linked to the ability to organise every day activities.

There is evidence of an age associated difference though this seems to depend on the nature of the memory task (Henry, MacLeod, Phillips & Crawford, 2004; Huppert et al, 2006). The particular measure used was from ELSA (Huppert et al, 2006) and closely based on a task incorporated in the UK Medical Research Council Cognitive Function and Aging Study (MRC CFAS) (Huppert, Johnson & Nickson, 2000).

PROCEDURES

Interviewer: *First, I would like you to remember to do a task in order to assess everyday memory. At some point during the interview I will hand you this piece of paper and a pencil. SHOW RESPONDENT THE PAPER When I do I would like you to write your date of birth on the line in the top left hand corner of the paper. Is that clear?*

After the FAS test (below), the interviewer handed the respondent the cognitive ability booklet along with a pencil and said *These are for you.*

The interviewer paused for exactly 5 seconds. If there has been no response, the interviewer prompts: *You were going to do something when I gave you the paper andpencil. Can you remember what it was*?

If the respondent asked a question, the interviewer responded, *Do whatever you think you are supposed to.*

The response codes were 1) Wrote date of birth in top left-hand corner, 2) Wrote date of birth somewhere else, 3) Wrote something else in top left-hand corner , or 4) Did something else.

NOTES

There is a variable for whether the interviewer prompts the respondent: **c_promem**. The outcome variable is **c_promem2**.

PHONEMIC FLUENCY

This task measures the ability to generate, access and produce words starting with a certain letter in one minute. Respondents were randomly assigned to words beginning with F, A, or S. As with the semantic fluency test in the main stage survey, the phonemic fluency test (also called FAS test) assesses some aspects of executive function in that the respondent must think of words beginning with a certain letter, monitor for duplicates and avoid responses that don't fit the rule--all within time limits. In laboratory situations the participant is often asked to do repeated trials beginning with different letters or switching between letters and categories. The task was adapted from Spreen & Strauss (1998).

PROCEDURES

Interviewer: *'Next, I am going to say a letter of the alphabet, and I want you to say as quickly as you can all of the words that you can think of that begin with that letter. For instance, if I say 'B', you might give me 'bad, battle, bed' and so forth. You may say any word at all except proper names of people or places, like 'Barbara' or 'Boston'. Also, do not use the same words again with a different ending, such as 'bake' and 'baking'. Often people think of a few words and then draw a blank. If this happens, just keep trying. You will have only one minute to do this, so please do not use your time to make other comments to me. Keep trying to think of words until the minute is up. Is this clear?'*

The interviewer began timing when the respondent produced the first word. If the respondent says, *I can't think of any more*, the interviewer gives encouragement—*Keep trying*. The interviewer writes the words in the cognitive ability booklet.

NOTES

The interviewer records the number of correct (**c_fasct2**) and number of incorrect words (**c_fasctctw**). There are variables about whether others were present and who they were.

SERIAL 7 SUBTRACTION

Working memory was assessed using the Serial 7 subtraction test. Working memory refers to short-term processes used to store and make use of information in more complex tasks. This is described in the list of measures for the main survey.

PROCEDURES

The procedures are about the same as in the main survey. In this test the interviewer asked the respondent to subtract 7 from 100, and continue subtracting 7 from each

subsequent answer for a total of 5 trials. In this question series, the respondent must remember the answer from the previous subtraction.

Scores could range from 0 (all wrong) to 5 (all correct). Each subtraction was scored independently. That is, if a respondent made a mistake on the first subtraction, but gave correct answers for subsequent subtractions, the score was 4. Respondents who refused to perform the test at the outset or who began the test and refused mid-way through were assigned missing values.

NOTES

No derived variables were created.

REFERENCES

Alley, D., Suthers, K., & Crimmins, E. M. (2007). Education and cognitive decline in older Americans: Results from the AHEAD sample. *Research on Aging, 29*(1), 73-94.

Banks, J., O'Dea, C., & Oldfield, Z. (2010). Cognitive Function, Numeracy and Retirement Saving Trajectories. *The Economic Journal, 120*(548), F381-F410.

Banks J, Breeze E, Lessof C, Nazroo J. (2006). *Retirement, health and relationships of the older person in England: The English Longitudinal Study on Ageing (Wave 2).* London: Institute for Fiscal Studies.

Batty, G. D., Wennerstad, K., Smith, G., Gunnell, D., Deary, I., Tynelius, P., et al. (2009). IQ in early adulthood and mortality by middle age. Cohort study of 1 million Swedish men. *Epidemiology, 20*(1), 100-109.

Borsch-Supan A., Brandt M., Hunkler C., Kneip T., Korbmacher J., Malter F., et al (2013). Data Resource Profile: The Survey of Health, Ageing and Retirement in Europe (SHARE). *International Journal of Epidemiology*. 42(4), 992-1001.

Bynner, J & Wadsworth, M (no date). Cognitive capital and the return to education and social change: lessons from the last 50 years. Report to Nuffield Foundation.

Carroll, J. (1993). *Human cognitive abilities. a survey of factor-analytic studies*. New York: Cambridge University Press.

Crimmins E. M., Kim, J. K., Langa, K. M. & Weir, D. R. (2011). Assessment of cognition using surveys and neuropsychological assessment: the Health and Retirement Study and the Aging, Demographics, and Memory Study. *Journals of Gerontology: Psychological Sciences*, **66B**(S1): i162-i171.

Crum, R. M., Anthony, J. C., Bassett, S. S., & Folstein, M. F. (1993). Population-based norms for the Mini-Mental State Examination by age and educational level. *JAMA, 269*(18), 2386-2391.

Deary, I. J. (2012). Intelligence. *Annual Review of Psychology, 63*, 453-482.

Delavande, A., Rohwedder, S. & Willis, R. (2008). Preparation for Retirement, Financial Literacy and Cognitive Resources. University of Michigan Retirement Research Center, WP-2008-190.

Farkas, G. (2004). Cognitive skills and non-cognitive traits and behaviors in stratification processes. *Annual Review of Sociology, 29*, 541-562.

Fisher, G. G., McArdle, J. J., McCammon, R. J., Sonnega, A. & Weir, D. (2013). New measures of fluid intelligence in the HRS. Available from http://hrsonline.isr.umich.edu/sitedocs/userg/dr-027.pdf.

Gottfredson, L. (2004). Intelligence: is it the epidemiologists' elusive 'fundamental cause' of social class inequalities in health? *Journal of Personality and Social Psychology, 86*, 174-199.

Gray, M., D'Ardenne, J., Balarjan, M., & Uhrig, N. (2011). Cognitive testing of wave 3 Understanding Society questions. *Understanding Society working paper*. Retrieved from https://www.understandingsociety.ac.uk/research/publications/working-paper/understanding-society/2011-03.

Heckman, J. J. Stixrud, J. & Urzua, S. 2006. The effects of cognitive and noncognitive abilities on labor market outcomes and social behavior. Journal of Labor Economics, 24(3), 411-482.

Henry, J. D., MacLeod, M. S., Phillips, L. H. & Crawford, J. R. (2004) A Meta-Analytic Review of Prospective Memory and Aging. Psychology and Aging, 19(1), 27-39.

Huppert, F. A., Gardener, E., & McWilliams, B. (2006). Cognitive function. In J. Banks, E. Breeze, C. Lessof & J. Nazroo (Eds.), *Retirement, health and relationships of the older person in England: The English Longitudinal Study on Ageing (Wave 2)* (pp. 217-230). London: Institute for Fiscal Studies.

Huppert, F. A., Brayne, C., Gill, C., Paykel, E. S., & Beardsall, L. (1995). CAMCOG--a concise neuropsychological test to assist dementia diagnosis: socio-demographic determinants in an elderly population sample. *British Journal of Clinical Psychology, 34 (Pt 4)*, 529-541.

Huppert, F. A., Johnson, T., & Nickson, J. (2000). High prevalence of prospective memory impairment in the elderly and in early-stage dementia: Findings from a population-based study. *Applied Cognitive Psychology, 14*(7), S63-S81.

Hurst, L., Stafford, M., Cooper, R., Hardy, R., Richards, M., & Kuh, D. (2013). Lifetime socioeconomic inequalities in physical and cognitive aging. *American Journal of Public Health, 103*(9), 1641-1648.

Jäckle, A., Lynn, P. & Burton, J. (2013). going online with a face-to-face household panel: initial results from an experiment on the Understanding Society Innovation Panel. *Understanding Society working paper.* Retrieved from https://www.understandingsociety.ac.uk/research/publications/working-paper/understanding-society/2013-03.

Kuh D, Pierce M, Adams J, Deanfield J, Ekelund U, Friberg P, et al. (2011) Cohort profile: updating the cohort profile for the MRC National Survey of Health and Development: a new clinic-based data collection for ageing research. *International Journal of Epidemiology, 40, e1-e9.*

Lachman, M. E., Agrigoroaei, S., Murphy, C., & Tun, P. A. (2010). Frequent cognitive activity compensates for education differences in episodic memory. *American Journal of Geriatric Psychiatry, 18*(1), 4-10.

Lang, F., Weiss, D., Stocker, A., & von Rosenbladt, B. (2007). Assessing cognitive capacities in computer-assisted survey research: Two ultra-short tests of intellectual ability in the German Socio-Economic Panel (SOEP). *Schmollers Jarbuch, 127*, 183-192.

Llewellyn, D. J., & Matthew, F. E. (2009). Increasing levels of semantic verbal fluency in elderly English adults. *Neuropsychology, development, and cognition. Section B, Aging, neuropsychology and cognition, 16*, 433-445.

McFall, Stephanie L. (ed.) (2012). *Understanding Society* –UK Household Longitudinal Study: Wave 1-2, 2009-2011, User Manual. Colchester: University of Essex .

McFall, Stephanie L., Petersen, Jakob, Kaminska, Olena, Lynn, Peter. (2013). *Understanding Society* –UK Household Longitudinal Study: Wave 2 Nurse Health Assessment, 2010-2012, Guide to Nurse Health Assessment. Colchester: University of Essex.

Ofstedal, M. B., Fisher, G. G., & Herzog, A. R. (2005). Documentation of cognitive functioning measures in the Health and Retirement Study, Available from http://hrsonline.isr.umich.edu/docs/usergdr-006.pdf.

Park, D. C., & Schwarz, N. (Eds.). (2012). *Cognitive aging: a primer*. New York: Psychological Press.

Park, D. C., & Reuter-Lorenz, P. (2009). The adaptive brain: aging and neurocognitive scaffolding. *Annual Review of Psychology, 60*, 173-196.

Richards, M., Sacker, A., & Deary, I. J. (2007). Lifetime antecedents of cognitive reserve. In Y. Stern (Ed.), *Cognitive reserve: theory and applications* (pp. 37-52). New York: Taylor and Francis.

Richards, M., Shipley, B., Fuhrer, R., & Wadsworth, M. E. (2004). Cognitive ability in childhood and cognitive decline in mid-life: longitudinal birth cohort study. *BMJ, 328*(7439), 552.

Richards, M., & Hatch, S. L. (2011). A life course approach to the development of mental skills. *Journals of Gerontology B Psychological Sciences Social Sciences, 66 Suppl 1*, i26-35.

Salthouse, T. A. (2010). Selective review of cognitive aging. *Journal of International Neuropsychological Society, 16*(5), 754-760.

Salthouse, T. (2012). Consequences of age-related cognitive declines. *Annual Review of Psychology, 63*, 201-226.

Savva, G. M., Maty, S. C., Setti, A., & Feeney, J. (2013). Cognitive and physical health of the older populations of England, the United States, and Ireland: international comparability of the Irish Longitudinal Study on Ageing. *Journal of American Geriatrics Society, 61 Suppl 2*, S291-298.

Schaie, K. W. (2005). *Developmental influences on adult intelligence*. New York: Oxford University Press.

Spreen, O., & Strauss, E. (1998). *A compendium of neuropsychological tests: administration, norms and commentary* (2nd ed.). Oxford: Oxford University Press.

Smith, J. P., McArdle, J. J., & Willis, R. J. (2009). Financial decision making and cognition in a family context. *Economic Journal, 120*, F363-F380.