

Proxying elderly cognition with survey responses to financial questions

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Introduction

- Cognitive decline is one of the most common conditions among the elderly
 - ▶ 10.8 % among 45–64 years old and 11.7 % among 65 years and older (CDC)
- Interest in maintaining a healthy later life has increased, focusing on the cognitive function being central to this interest
- A growing amount of evidence suggests further investigation of the cause and effect of cognitive decline
- However, the lack of data availability limits the scope of research
- In this paper, I propose a measure as a proxy of cognitive ability based on the response patterns of popular surveys

Features of Survey Response

- Participating in a survey requires mental effort
- Incomplete answers are frequently observed in open-ended questions
 - ▶ round numbers or missing responses
- Focus on the open-ended *financial* questions
 - ▶ available in popular survey-type microdata
 - ▶ the financial questions demands advanced mental operations (Riddles et al. 2017)
 - ▶ financial literacy is often associated with cognitive abilities (Cole and Shastry 2008, Bucher-Koenen and Ziegelmeier 2011)
- Analyzing the response patterns of the financial questions would provide a better understanding of cognitive functioning

Motivation

- Stylized patterns are observed in open-ended questions
 - ▶ strong patterns of heaping on approximate number, rounded to precision of 1
e.g. 2,000 or 10,000 figure
 - ▶ opt-out trends in aging
- Assume that the response format is related to cognitive ability
- Construct the proxy based on the response formats on the selected questions in the HRS
- Apply a similar method to construct the proxy using the PSID data

Preview on Findings

- The proxy starts to decline from the mid-60s
- It is positively correlated with correlated with cognitive ability, directly measured by the HRS
- Similar patterns are observed in the PSID
- As an application of the project, the impact of the Title VI of the 1964 Civil Rights Act on black people's cognitive development
 - ▶ find some evidence to support this claim

Road Map

- ① Literature Review
- ② Data
- ③ Framework
- ④ Validation
- ⑤ PSID Application
- ⑥ Conclusion

Literature Review

- Opt-out answers are considered as taking cognitive shortcuts to make answering easier (Colsher and Wallace 1989, Krosnick 1991, Knäuper et al. 1997)
 - ▶ old respondents are more likely to skip or choose opt-outs
 - ▶ the respondents with low cognitive ability tend to opt out of the question more on difficult questions
- Another set of papers examine the relationship between cognitive ability and the pattern of numerical response (Andrews and Herzog 1986, Holbrook et al. 2014, Gideon, Helppie-McFall and Hsu 2017)
 - ▶ strong patterns of heaping at round numbers
 - ▶ rounding was more common for respondents low in ability, for respondents low in motivation, and for more difficult questions
- To the best of my knowledge, there is no research on estimating cognitive ability using the response pattern

Data Description

- Health and Retirement Study

- ▶ focus on the household heads aged between 50 and 89, participated in 2004–2018 survey
- ▶ 62,851 individual-years, pooling 16,187 individuals across 7 waves

[summary](#)

- Question selection criteria

- ▶ response format should be open-ended and require more than 2-digit numbers
- ▶ response rate should be large enough
- ▶ the selected questions should appear in multiple waves
- ▶ 10 questions are selected

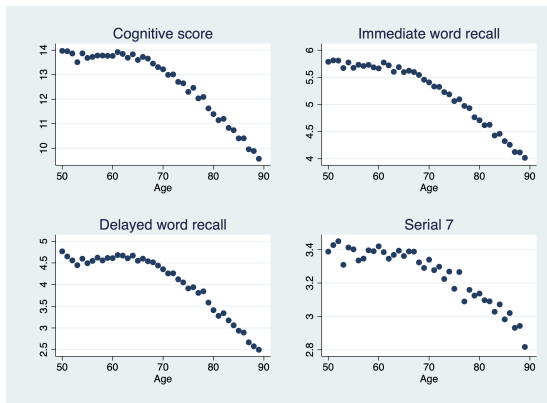
Response patterns in the HRS

variable	maximal rounding (%)	Opt-out (%)		
		Don't know	Refused to Answer	skip
Home value	30.9	15.6	1.2	11.9
Property tax	26	18.8	1.4	1.2
SSI income	22.6	12.5	.8	8.3
Checking	48.2	11	10.5	.8
Vehicle	53.1	17.7	1.4	.8
Food home	61	9.9	1	.6
Food out	42	3.1	.7	.5
OOP Doc	51.9	18.1	.6	1.2
OOP Dent	59.9	7.5	.5	1.1
OOP Drug	45.3	11.8	.4	5.6

- Maximal rounding indicates the numerical response, rounded to the precision of 1

Cognitive score in the HRS

- Following measures are selected to construct *cognitive score*
 - ▶ immediate recall, delayed recall, serial 7 (Herzog and Wallace, 1995)



Satisficing Theory

- Respondents either provide numerical values or opt out of the question
 - ▶ opt-out responses indicates *don't know, refused to answer, skip*
- Providing incomplete answers are called *satisficing* (Krosnick 1991)
 - ▶ claim that the satisficing behavior is negatively correlated with cognitive ability
- Investigate whether the cognitive ability could be inferred from the response patterns
- Propose a standardized method that enables cross-question comparisons in answering behavior

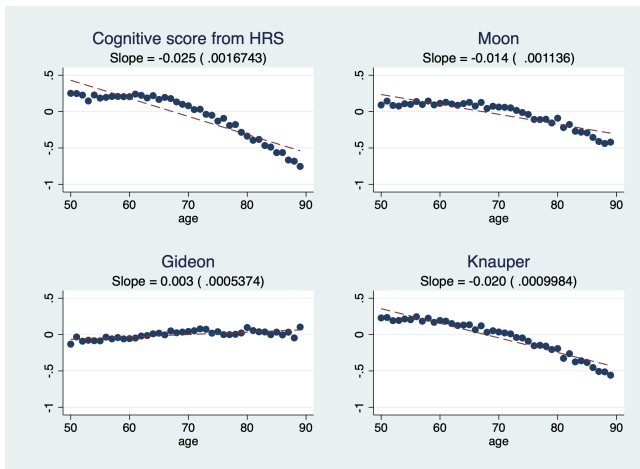
Characterizing the response

- Level of rounding would help characterize the numerical response
 - ▶ assume round responses is a consequence of satisficing
 - Gideon et al. 2017 define the level of rounding as $\left(\frac{\text{the number of total digits} - \text{the number of significant digits}}{\text{the number of total digits} - 1} \right)$ figure
 - raises the question of whether it would be sufficient to focus just on the maximal rounding figure
- The reductions in cognitive ability can be reflected in the completion rate (Knäuper et al. 1997)
 - ▶ use a dummy indicating the opt-out responses figure
- Ideal proxy should be responsive to the level of rounding and opt-out responses
- Divide the response format into three: opt-out, maximal rounding, and numerical answer
 - ▶ assign 0,1 and 2 to each type in order
 - ▶ assume that they represent the respondent's cognitive ability in that order.

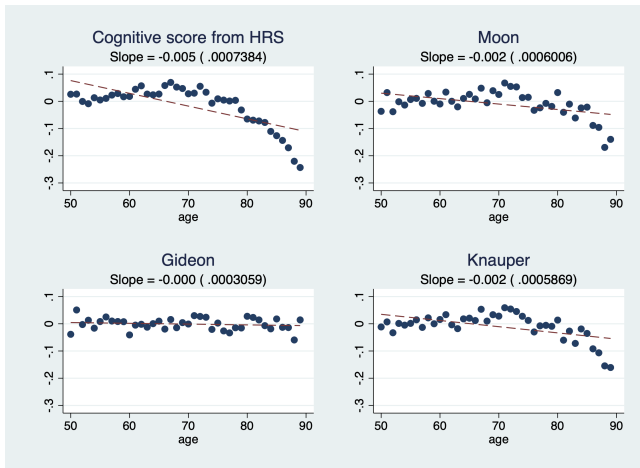
Choices of Cognitive Proxy

- Label the above method *Moon*
- For comparison, employ two other ways of classifications
 - ▶ *Gideon*: level of rounding
 - ▶ *Knäuper*: opt-out responses
- After characterizing response using these three ways, I take the average of them
- To make the higher value of the proxies to imply higher cognitive ability
 - ▶ use 1 – *levelofrounding* for Gideon
- Evaluate the proxy based two aspects
 - ▶ need to have trends in aging
 - ▶ correlate with the cognitive measures

Proxy Evaluation I: Trends in Aging



Proxy Evaluation I: Trends in Aging controlling for individual effects



Proxy Evaluation II: Regression Analysis

- Cognitive development would be affected by income, education, and gender (Myers 1976, Budd and Guinnane 1991, Boyle and Gráda 1986)
- Regression analysis on the proxies to evaluate whether the resulting associations are consistent with literature

Descriptive statistics for the HRS respondents

variable	overall	<65	≥65
age	68.5	57.9	75.3
female	0.73	0.69	0.75
year of education	12.42	12.87	12.13
phone interview	0.45	0.46	0.44
total wealth (\$1,000)	81	71	87
observations	62,851	24,801	38,050

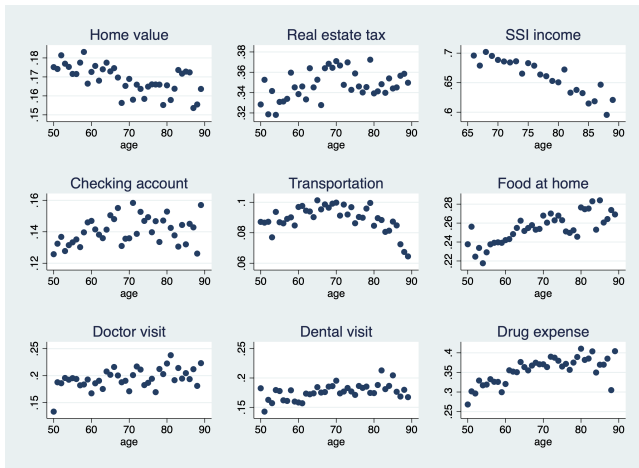
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Descriptive statistics for the HRS respondents



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Level of rounding by age



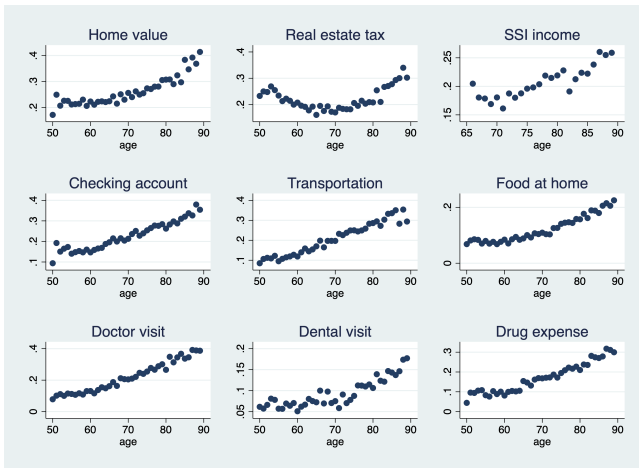
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Maximal rounding by age



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Opt-out trend by age



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