Online Appendix
Cognitive Decline, Limited Awareness, Imperfect Agency, and Financial Well-being

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A Details of the VRI sample and comparison with the Health and Retirement Study sample

A1 Details of the VRI sample characteristics and comparison with the HRS

Table A1 presents the key characteristics of the VRI sample (Vanguard Research Initiative, 2020) who completed the main survey, the main sample used in this paper. The mean age is 74 years, with the inter-quartile range of 68-78.[1] By construction, the VRI sample is composed of wealthholders. The median and mean financial wealth are $1.2M and $1.9M; the median and mean net worth are $1.6M and $2.4M. The sample also has an overall high level of education: 76% have a college degree and 43% have a post-college degree. A majority of the sample (67%) report that they are in excellent or very good health. The VRI oversamples singles: About a third of the sample are singles.

Table A1: VRI sample characteristics

	Age and Wealth					
	10p	**25p**	**50p**	**75p**	**90p**	**Mean**
Age	64	68	74	78	83	74
Financial wealth	265,000	592,000	1,165,813	2,300,000	4,100,000	1,909,950
Net worth	470,000	873,800	1,630,000	2,923,623	5,022,813	2,401,415

Married		Education		
Yes	**No**	**< College**	**College**	**> College**
65%	35%	24%	33%	43%

Sex		Health		
		Excellent/		**Fair/**
Female	**Male**	**Very Good**	**Good**	**Poor**
32%	68%	67%	26%	7%

Notes: N=2,489. Financial wealth is the sum of balances in all tax-deferred accounts and non-tax-deferred accounts. Net worth is financial wealth plus home values minus mortgage balances.

[1]The sample for this survey is composed of two cohorts: One first invited to the panel in 2013 and the other in 2016. Since the minimum age cutoff (55 years old) is applied at the moment of invitation, the effective age cutoff for the current survey is 62 years old for the first cohort and 59 years old for the second cohort.

In Table A2 we report the distribution of the same variables from the Health and Retirement Study (HRS) sample (Health and Retirement Study, 2021, wave 2016). Panel A shows the distribution of the HRS sample that are age 59 and above, given that the age-eligibility criteria (55+) for the VRI sample was applied four years before the survey used in the current study. Compared to the age-eligible HRS sample, the VRI sample (Table A1) is wealthier, healthier, and more educated. The median financial wealth and net worth are about $42,000 and $220,000 in the HRS sample, compared to $1.2M and $1.6M in the VRI sample. The VRI has good coverage of the above-median range of the U.S. net-worth distribution, with the 10th and 50th percentiles from the VRI close to the 60th and 90th percentiles from the HRS. In the HRS, 39% are in excellent or very good health and 31% completed college, compared to 67% and 76% in the VRI sample.

Note that a large part of this difference is due to the sampling criteria we imposed on the VRI sample: They have to have at least $10,000 in non-transactional accounts and internet access. When we impose the same sampling criteria ex-post on the HRS sample (Panel B, Table A2), the sample characteristics become much closer to that of the VRI, though that does not remove the entire gap. The median financial wealth ($330,000) and net worth ($640,000) of the VRI-eligible HRS sample are several times larger than those of the all age-eligible HRS sample ($42,000 and $220,000) though still fall short compared to those of the VRI ($1.2M and $1.6M). One caveat for the comparison in terms of financial wealth and net worth is that the stock market indices have increased by about 50% between 2016 and July 2020. Given that the average stock share out of the financial portfolio is around 60% among the VRI sample, the change in the market between these two observation points significantly contributes to the observed gap in wealth. Among the VRI-eligible HRS sample, 55% are in excellent or very good health and 53% completed college; these numbers are much closer to the VRI averages.

There is no discernible selection into non-response on observable variables. Ameriks et al. (2014) presents a detailed response analysis of the initial VRI survey and establishes that characteristics observed in the Vanguard administrative data, such as age and asset held at Vanguard, are not meaningfully different between those who participated in the survey and those who did not. Invitations to the later surveys were conditional on completing previous surveys. To be invited to Survey 7, which is used in this paper, the respondents had to complete either Survey 5 or Survey 6. Because Survey 5 provides a precise measure of total assets held, we compare the select characteristics observed in Survey 5—age, wealth, and education—between those who completed Survey 7 and those who did not.[2] Table A3

[2]A small fraction of those invited to Survey 7 did not complete Survey 5. They are not included in this analysis.

Table A2: HRS sample characteristics

A. Age-eligible HRS

	Age and Wealth					
	10p	**25p**	**50p**	**75p**	**90p**	**Mean**
Age	60	63	69	76	84	70
Financial wealth	-2,113	11	42,711	297,736	919,106	350,683
Net worth	541	44,874	222,207	662,837	1,579,989	669,901

Married		Education	
Yes	**No**	**< College**	**≥ College**
51%	49%	69%	31%

Sex		Health		
		Excellent/ Very Good	**Good**	**Fair/ Poor**
Female	**Male**			
52%	48%	39%	35%	26%

B. VRI-eligible HRS

	Age and Wealth					
	10p	**25p**	**50p**	**75p**	**90p**	**Mean**
Age	60	63	67	73	79	68
Financial wealth	54,065	126,512	328,715	843,415	1,701,968	754,047
Net worth	155,707	308,711	646,618	1,387,309	2,703,743	1,270,059

Married		Education	
Yes	**No**	**< College**	**≥ College**
67%	33%	47%	53%

Sex		Health		
		Excellent/ Very Good	**Good**	**Fair/ Poor**
Female	**Male**			
44%	56%	55%	32%	12%

Notes: The table uses financial respondents in Health and Retirement Study (2021), wave 2016. Panel A uses everyone with age 59+ while being in Panel B also requires having at least $10,000 in non-transactional accounts and internet access. N= 9,924 for Panel A and N=2,875 for Panel B. Financial wealth and net worth are in 2020 dollars.

reports the results. The characteristics of the two groups are very similar. If anything, those who completed Survey 7 are more likely to have a post-college degree and to be in the top wealth quartile, but the differences are small.

Table A3: Sample characteristics by participation in Survey 7

	Non-Respondents	Respondents
A. Age		
55-59	11.3%	9.7%
60-64	17.7%	18.0%
65-69	21.1%	23.1%
70-74	23.7%	25.4%
75+	26.2%	23.8%
B. Asset quartiles		
1st (lowest)	28.0%	21.3%
2nd	25.6%	24.3%
3rd	23.8%	26.5%
4th (highest)	22.6%	27.9%
C. Education		
Less than college	25.4%	20.2%
College degree	32.1%	33.6%
Post college	42.5%	46.2%
N	2,305	2,779

Notes: This table compares the characteristics of those who did and did not complete Survey 7. Those who started but did not complete the survey are included as non-respondents. Sample characteristics are from Survey 5.

A2 Details of the subjective probability of having cognitive decline and comparison with the realized probability in the HRS

This Appendix reports the distribution of the subjective probability of having cognitive decline and compares that with the realized chance of having cognitive decline calculated from the HRS.

Table A4 (Panel A) reports the subjective probability from the VRI sample. The median probability is 15%, while the mean is 29%. The small difference between the perceived chances of having it at least for one year and at least for five years suggests that respondents do not expect this to be a short experience conditional on it happening.

There is also a strong heterogeneity in beliefs. One characteristic that explains this heterogeneity is whether the respondents had a family member or someone close to them that experienced cognitive decline. About 60% of the sample observed someone close to them suffering cognitive decline. Both mean and median subjective probabilities in this group (Table A4, Panel B) are half as many again as those in the complement group (Table A4, Panel C).

Table A4: Subjective probability of having cognitive decline in the VRI (%)

A. All	**10p**	**25p**	**50p**	**75p**	**90p**	**Mean**	**N**
For at least one year	0	5	15	55	85	30	2,489
For at least five years	0	5	15	45	75	29	2,489
B. Sub-sample that have someone close who experienced cognitive decline	**10p**	**25p**	**50p**	**75p**	**90p**	**Mean**	**N**
For at least one year	0	5	25	65	95	35	1,499
For at least five years	0	5	25	55	75	33	1,499
C. Sub-sample that do not have someone close who experienced cognitive decline	**10p**	**25p**	**50p**	**75p**	**90p**	**Mean**	**N**
For at least one year	0	5	15	25	75	22	990
For at least five years	0	5	15	25	65	22	990

In contrast to the VRI that asks about the subjective expectations of having cognitive decline, the HRS asks about the current cognitive status. We can use these data to infer the chance of having cognitive decline from the realized path of cognitive decline in the HRS as a function of observables. We can then compare the realized incidence from the HRS with the subjective expectations from the VRI.

The HRS provides the cognitive ability score (RxCOGTOT in the RAND version) based on many tests, including word recall, number series, etc. It is unclear what level of this score can be used as a threshold for cognitive decline. To get a sense of this, in Table A5, we tabulate the distribution of the cognitive ability score by age group and by whether the respondent has any difficulty in managing money-related issues among the VRI-eligible HRS sample. The idea is that we can determine a threshold such that a score that corresponds to cognitive decline is very rare before age 70 and among those who do not experience any

difficulty in handling money-related issues, while that score is more common among older age groups and among those who do have difficulty in handling money-related issues. From the observations in Table A5, we define cognitive decline as having a score lower than 20, because that satisfies those conditions. Less than 10% of the sample below age 70 have a score lower than 20, but the share increases significantly for higher ages, to close to 50% for those with 90+. A threshold value of 20 also produces the desired pattern in the data by whether they have an issue in dealing with money or not.

Table A5: Cognitive ability score distribution in the HRS

A. By age group	**10p**	**25p**	**50p**	**75p**	**90p**	**Mean**	**N**
50-59	21	23	25	27	29	25.1	3,420
60-69	20	23	25	27	29	25.0	7,935
70-79	19	22	24	27	28	24.0	10,181
80-89	16	19	22	25	27	21.9	2,990
90-	13	17	20	23	25	19.2	263

B. Whether have an issue in dealing with money	**10p**	**25p**	**50p**	**75p**	**90p**	**Mean**	**N**
Yes	19	22	25	27	29	24.3	24,066
No	10	16	20	24	27	19.4	464

Notes: This table tabulates the distribution of the cognitive ability scores (RxCOGTOT in the RAND version) from the VRI-eligible HRS sample (Health and Retirement Study, 2019, wave 2002-2014).

Using this observation from the HRS, we calculate the chance of having cognitive decline as a function of current age, health status, and sex in the following way. First, for each observation in the HRS, we classify the health status into the following categories that include cognitive decline: (i) good with no cognitive decline (self-reported health being excellent, very good, or good and not having cognitive decline), (ii) bad with cognitive decline (self-reported health being fair or poor and not having cognitive decline), and (iii) with cognitive decline. We estimate the probability of being in each health state (including the possibility of death) in the next period as a function of the current health state as well as age, age squared, sex, and interactions between these terms using a multinomial logit. We construct the transition matrix for health states as a function of age and sex using the estimation results. Finally, we run simulations to calculate the chance of having cognitive decline for at least five years before death as a function of current health, age, and sex. This allows us

to calculate the chance of having cognitive decline for each VRI respondent and compare it with his own subjective expectation.

Table A6 compares the subjective probability reported in the VRI and the probability from the simulations described above. With the caveat that what the VRI respondents had in mind may not be the same as the threshold we used in defining cognitive decline in the HRS (the cognitive score being lower than 20), many VRI respondents turn out to be optimistic, under-estimating the chance of having cognitive decline. At the same time, there are a non-negligible fraction of respondents that report a high probability, making the average of the subjective expectation comparable to that of the realized probability.

Table A6: Subjective versus realized probability of having cognitive decline

	25p	**50p**	**75p**	**Mean**	**N**
VRI-subjective	5	15	45	29	2,489
HRS-realized	34	37	39	34	2,489

Notes: Subjective probability is self-reported in the VRI. Realized probability is calculated from the realized cognitive decline in the HRS as explained in the text.

B Details of the VRI cognitive decline survey

This appendix provides key details of the VRI cognitive decline survey (Survey 7). See the VRI website (http://ebp-projects.isr.umich.edu/VRI/) for the full survey instrument.

B1 Quantitative question on the quality of decisionmakers in the pilot survey

The pilot survey asks a question that compares the expected quality of decisions to be made by (i) the agent and (ii) the self with cognitive decline to that of the self without cognitive decline. The question aims to measure the gap in the quality of decisions quantitatively by asking for the amount of wealth compensation needed to make up for the lower quality of decisions by a worse decisionmaker. The design of this question shares common features with the quantitative question in the main survey that is discussed in detail in Section IID and in Appendix B2, so we will be brief in describing this question and focus on the different features compared to the main survey question. The question assumes that the respondent has five more years to live and will experience significant cognitive decline for those five years. The amount of financial resources at the beginning of the five years ($\$W$) is set to be close to their actual net worth.[3] Out of this money, they have to decide how to spend on their behalf, how to save for the future and manage investment, and how to give to relatives and significant others.

The question asks respondents to compare two situations:

1. Counterfactually, the self without cognitive decline can observe the needs and desires of the self with cognitive decline in the assumed situation and make decisions on behalf of the self with cognitive decline.

2. The agent makes decisions on behalf of the self with cognitive decline.

To compare the quality of two "decisionmakers" considered, the survey allows the money given in the second situation to be different from $\$W$ and asks for the amount of adjustment in wealth needed to make them indifferent between these two situations. The compensation can be negative if respondents think the agent is a better decisionmaker than the self without cognitive decline. It is therefore asking for the value of x_W that satisfies:

$$\nu_S(W) = \nu_A([1 + x_W]W), \tag{1}$$

[3] The survey uses the nearest multiple of $500,000 to respondents' actual net worth. If the net worth is below $250,000, it uses $500,000.

where ν_S is the utility from the last five years of life with the self without cognitive decline as the decisionmaker and ν_A is that with the agent as the decisionmaker. We repeat this question replacing the agent with the self with cognitive decline.

Table B1 shows the measured compensating variation in wealth. Most respondents think the agent's quality of decisions is worse than that by the self without cognitive decline. But the measured gap is not large. At the median, the respondents only request 3% of the baseline wealth. The average is larger at 13%. Overall, the respondents think that the agent is not as good as the current self in making decisions on their behalf, but also not too bad. On the other hand, the respondents report much larger compensating variations when the self with cognitive decline is a decisionmaker. The median is 45%. The mean is 52%, but this is an under-estimation of the actual mean as the responses from more than 10% of the sample are at 100%, which is the maximum response allowed. Overall, the respondents think that it is going to be disastrous if the self with cognitive decline continues to make financial decisions.

Table B1: Quality of decisionmakers compared to the self without cognitive decline: measured in compensating variation in wealth (in % of wealth)

Decisionmaker	**10p**	**25p**	**50p**	**75p**	**90p**	**Mean**
Agent	-10	0	3	25	50	13
Self with cognitive decline	20	20	45	97	100	52

Notes: N=279. The maximum response allowed is 100%.

B2 Script of the battery on the timing of transfer of control in the main survey

Setting up the hypothetical situation

In this part of the survey, we are going to ask your view on how helpful your ***likely agent*** *("Likely Nickname"[4]) would be in making spending and saving decisions for you, if you have cognitive decline. To standardize the questions across respondents, we present a* ***hypothetical situation*** *about your* ***age***, ***health***, *and* ***wealth***.

Even if it is hard to imagine yourself in this hypothetical situation, please try your best.

The ***hypothetical situation***:

[4]This is a string defined as the nickname of the agent that a respondent assigns during the survey.

- *You experience cognitive decline*
- *You have five years to live with this cognitive decline*
- *You have a fixed amount of resources equal to $W to meet all your wants and needs for these five years.*[5]

Decisions need to be made on how to spend or save this fixed amount of resources.

Table B2: Distribution of resources assumed in the hypothetical situation

	10p	**25p**	**50p**	**75p**	**90p**	**Mean**
$W	500,000	1,000,000	2,000,000	3,000,000	5,500,000	2,646,645

Notes: N=2,489.

[Change in the screen]

In this hypothetical situation, the following decisions about your resources need to be made.

- *How to spend on your behalf, for example,*
  - *Routine spending including food, housing, clothing, and transportation.*
  - *Non-routine spending including travel and entertainment.*
  - *Paying for long-term care at home or in a nursing home if you need long-term care.*
- *Saving for your future and managing your investments*
- *Giving to your relatives, friends, or charities*

For each of these categories, we will ask you to consider decisions about both the amount of resources to be used and the details of the spending. For example, decisions need to be made on the type and quality of long-term care service you will have, or what investment strategies to use.

[Change in the screen]

*We will now fix the details of the **hypothetical situation**:*

[5]The survey uses the nearest multiple of $500,000 to respondents' actual net worth. If the net worth is below $250,000, it uses $500,000. See Table B2 for the distribution of $W.

- *You are* $max\{85, currentage + 10\}$ *years old.*
- *You will live for only 5 more years.*
- *You live alone. (If married: Please assume that your spouse/partner has already passed away.)*
- *You have cognitive decline.*

Cognitive decline means a deterioration in your abilities in

- *Remembering things*
- *Learning new things in general*
- *Making decisions on everyday matters*
- *Handling financial matters (for example, your pension or dealing with the bank)*
- *Using your intelligence to reason things through*

Here are more details on how your cognitive decline will develop in these five years. ***In the first year, your cognitive decline is very mild.*** *You continue with your everyday life as usual, but you will notice some signs of deterioration in at least one of the aspects listed above.*

The progression of your cognitive decline during the rest of the five years is uncertain.

Please consider the most likely situation you can envision, given the mild but noticeable cognitive decline in the first year.

Defining the transfer of control

In the hypothetical situation where you experience gradual cognitive decline, a transfer of control of your financial assets and investments to the ***likely agent*** *may be a way to protect your financial well-being. This* ***transfer of control*** *may take a legal or a more informal form, such as:*

- *Allowing your* ***likely agent*** *("likely nickname") to monitor your accounts or to make transactions on your behalf*
- *Limiting your ability to make transactions, make large purchases, and/or change investment strategies*

- *Consulting your **likely agent** ("likely nickname") whenever making important financial decisions*

*This transfer may happen in a gradual way. You may start out generally making the decisions yourself and then occasionally, making some joint decisions with your **likely agent** ("Likely nickname"). For purposes of this question, the transfer of control should be interpreted as effectively giving your **likely agent** ("likely nickname") main control over your finances.*

When you consider the transfer of control in this hypothetical situation, please focus only on how well your wants and needs will be addressed by the agent. As best you can, try to ignore emotions that may accompany your choice of a specific person as your agent. For example, please try to ignore feelings about giving control to someone who is not a family member or feelings about burdening a child.

Introducing the concept of the "idealized agent"[6]

*We now will ask about the timing of the transfer of control to your **likely agent** ("Likely nickname"). To better conceptualize this question, we introduce a new agent, called an **idealized agent**. Note that this is a hypothetical agent, but this agent's decisions align with what yourself, without cognitive decline, would choose. The only difference is that the **idealized agent** is able to observe how your cognitive decline progresses and how that affects you.*

Therefore, the idealized agent

- *continuously observes the state of your cognitive decline,*
- *understands your wants and needs,*
- *makes decisions in your interest, and*
- *has the same cognitive ability and financial knowledge that you have now.*

*The only role of the idealized agent is to determine when to transfer control over financial decisions from you with cognitive decline to your **likely agent** ("Likely nickname").*

Question on the optimal timing of the transfer

[6]The idealized self is effectively the same as the self without cognitive decline. We introduced this concept so that we can ask about the optimal timing of the transfer of control under the current self's view without using the concept "self" in different ways in the questions. Before the survey proceeds to the main questions, the survey checks the respondents' understanding of this concept.

We now will ask about the timing of the transfer of control of financial decision making were you to experience progressive cognitive decline.

*When would you expect the **idealized agent** to transfer control from **you with cognitive decline** to your **likely agent** ("Likely nickname")?*

1. *Immediately at the onset of cognitive decline*
2. *During the further decline, but before you completely lose the ability to manage your finances*
3. *When you completely lose the ability to manage your finances*

Asking about the chance of a delayed and an early transfer

*Now suppose the **idealized agent** is not available to determine the timing of the transfer of control. Instead, this decision on the transfer of control is left to **you with cognitive decline** and **your likely agent** ("likely nickname").*

*In other words, the transfer of control may happen at a different time than the **idealized agent** would determine.*

*The transfer may be **delayed** compared to the idealized agent's timing for reasons including:*

- *You do not notice your own decline*
- *You with cognitive decline does not want to give up the control.*
- *Your **likely agent** ("Likely nickname") does not notice your decline*
- *Your **likely agent** ("Likely nickname") is not available to take over control of your finances.*

*The transfer may happen **earlier** than the idealized agent's timing for reasons including:*

- *You with cognitive decline becomes very concerned about the progression of your cognitive decline*
- *Your **likely agent** ("Likely nickname") becomes very concerned about the progression of your cognitive decline*

*Q. Overall, what is the percent chance that the transfer of control will be **delayed** compared to the idealized agent's timing?*

$\{0\%, 5\%, 15\%, 25\%, \cdots, 85\%, 95\%, 100\%\}$

*Q. Overall, what is the percent chance that the transfer of control will happen **earlier** than the idealized agent's timing?*

$\{0\%, 5\%, 15\%, 25\%, \cdots, 85\%, 95\%, 100\%\}$

*Q. What would worry you more, **delayed transfer or early transfer** of control relative to the idealized agent's timing?*

1. *A delayed transfer*

2. *An early transfer*

Comparing the transfer at the optimal timing and that at the wrong time[7]

In this question, we ask you to consider how a delayed transfer of control may affect the quality of financial decisions. We will ask you to compare two scenarios.

- *Scenario 1: The transfer of control from you with cognitive decline to your likely agent ("Likely nickname") is determined by the idealized agent's timing, which you said is "[present the option chosen from the question on the optimal timing]."*

- *Scenario 2: The transfer of control from you with cognitive decline to your likely agent ("Likely nickname") is determined by you with cognitive decline and your likely agent ("Likely nickname") and is delayed relative to the timing in Scenario 1.*

In a previous question, you answered that the chance of the delay such as the one described in Scenario 2 is about [present the subjective probability of a delayed transfer reported] percent. Please think about this potential delay in comparing Scenario 1 and Scenario 2.

Recall that in either scenario you have $W in resources. The following decisions about your resources need to be made.

- *Spending on your behalf includes, for example:*

  - *Routine spending including food, housing, clothing, and transportation.*

[7] Here we show the script on the branch focusing on a delayed transfer. The structure and wording for the branch focusing on an early transfer is symmetric.

  - *Non-routine spending including travel and entertainment.*
  - *Paying for long-term care at home or in a nursing home, if you need long-term care*

- *Saving for your future and managing your investments*
- *Giving to your relatives, friends, or charities*

You with cognitive decline make decisions until the transfer of control while your likely agent ("Likely nickname") makes decisions after the transfer of control.

Q. In which scenario would you be better off with the spending and saving decisions?

- *Scenario 1 (transfer of control at the idealized agent's timing)*
- *Scenario 2 (delayed transfer of control compared to the idealized agent's timing)*

Now we will ask a series of questions comparing spending and saving decisions made under different scenarios. In general, a scenario with better decisions can make you as well off with less resources than a scenario with worse decisions. Therefore, the following questions will ask about ***tradeoffs*** *between having more or less resources with having better or worse decisions.*

[Change in the screen]

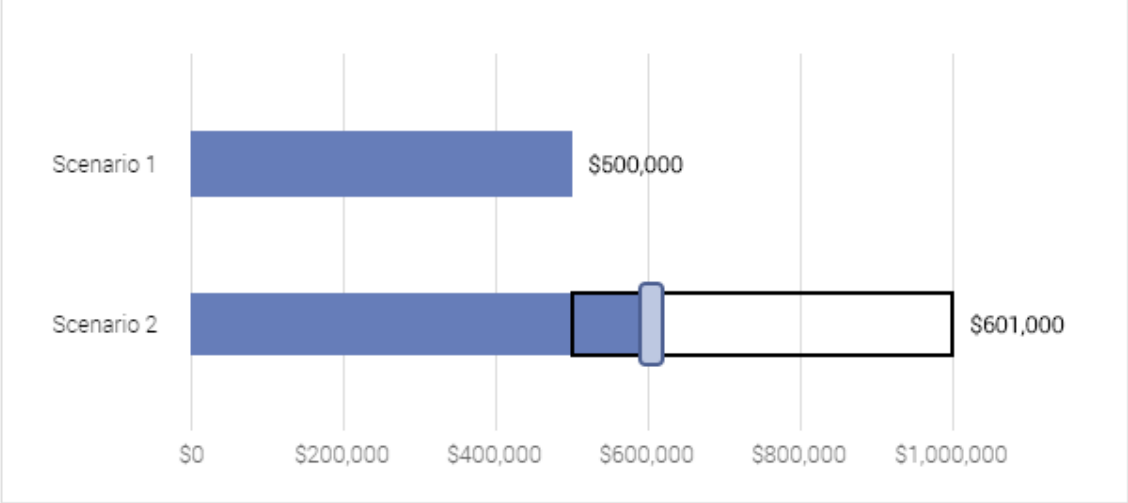
Q. Your previous response indicates that you would be better off with the spending and saving decisions made under ***Scenario 1*** *with $W in resources than those under* ***Scenario 2 (transfer delayed)*** *with $W in resources. Imagine, instead, that the resources available under* ***Scenario 2*** *is increased from $W. At what level of resources would you be* ***just as well off*** *with the spending and saving decisions under* ***Scenario 2*** *as with those under* ***Scenario 1*** *with $W?*[8]

To make a selection of resources available under ***Scenario 2****, click anywhere in the empty box to the right of the blue bar for* ***Scenario 2****. A slider will appear at the point you click. The text below the bar tells you how you can interpret your current selection. You can adjust the amount of resources available under* ***Scenario 2*** *by moving the slider to the left or right. When you agree with the text below the chart under the current selection, please click "Next."*

[A slider interface captured in Figure B1 is posited here.]

[8]This is the text that a respondent who chose Scenario 1 in the previous question sees. A respondent who chose Scenario 2 in the previous question (which is a very small fraction of the sample) sees a text where the resources given to Scenario 2 is decreased instead of increased.

Figure B1: Slider interface to measure compensating variation in wealth



B3 Strategic survey questions to measure the marginal value of resources with and without cognitive decline

The marginal value of resources under cognitive decline can be different from that under no cognitive decline. On the one hand, one may want to have more resources under cognitive decline as cognitive decline may be accompanied by physical decline and hence a need for long-term care, which is costly. On the other hand, one may discount own needs and desires under cognitive decline if she expects cognitive decline to affect abilities to appreciate consumption.

To measure the relative marginal values of resources with and without cognitive decline, based on Ameriks et al. (2020), we ask the following strategic survey question (SSQ). The question assumes that the respondent is at the beginning of the last five years of her life. It further assumes that there is uncertainty in whether she will experience cognitive decline during these five years, as in the main question battery in this survey, or not. The chance of having cognitive decline is given as $\pi_{CD} = 25\%$. The respondent has a given amount of wealth, $\bar{W}$. The respondent is asked to allocate this wealth into two lockboxes, A and B. Each dollar invested in Lockbox A will give $1/\pi_{CD} = 4$ dollars only if the respondent turns out to have cognitive decline; It will give nothing if the respondent does not experience cognitive decline. Each dollar invested in Lockbox B will give one dollar if the respondent does not experience cognitive decline; Under cognitive decline, it will give nothing. The question assumes that the transfer of control will happen at the optimal timing, in case having cognitive decline.

The decision the respondents make is to choose the optimal value of W_{CD} that maximizes:

$$\pi_{CD}\bar{\nu}(W_{CD}) + (1 - \pi_{CD})\nu(W_N), \tag{B1}$$

such that:

$$W_{CD} = \frac{1}{\pi_{CD}}(\bar{W} - W_N). \tag{B2}$$

where W_{CD} and W_N are resources with and without cognitive decline, $\bar{\nu}$ is the utility from the last five years of life under cognitive decline (assuming the optimal timing of the transfer), and ν is the utility from the last five years of life under no cognitive decline. We parameterize the utility functions based on Ameriks et al. (2020):

$$\bar{\nu}(W) = \eta^{\frac{1}{\theta}}\frac{W^{(1-\frac{1}{\theta})}}{1-\frac{1}{\theta}}, \nu(W) = \frac{W^{(1-\frac{1}{\theta})}}{1-\frac{1}{\theta}}, \tag{B3}$$

where η governs the relative magnitude of marginal utility under cognitive decline. Then the ratio of resources respondents choose, W_{CD}/W_N, is mapped into η by:

$$\eta = \frac{W_{CD}}{W_N}(1 - \pi_{CD})^{\theta}. \tag{B4}$$

We set θ, the risk preference parameter in both utility functions, to be at 0.33 (i.e., the relative risk aversion coefficient at 3).

Table B3 reports the ratio between the amounts of resources the respondents want to hold in the two states (W_{CD}/W). Most of the respondents choose to have more resources under cognitive decline than under no cognitive decline. As a result, η is larger than one for the vast majority of respondents. Note that this is not at odds with Brown, Goda and McGarry (2016), who find the marginal utility to be lower under cognitive decline: They focus on utilities of non-care consumption by assuming that the costs of care are covered in the hypothetical situation in their survey, while we do not make such an assumption.

Table B3: Ratio between the desired amounts of resources under cognitive decline versus that under no cognitive decline

	25p	**50p**	**75p**	**Mean**	**N**
W_{CD}/W**:**	1.00	1.80	3.85	8.78	2,489

C Credibility of responses

In this appendix, we provide evidence supporting the credibility of the survey responses reported in the main text. First, using the comprehension test questions implemented in the survey, we show that the respondents overall had a good understanding of the hypothetical situation before they answered the main battery. Second, we show that their responses to hypothetical questions are correlated with the responses to factual questions in the anticipated direction.

C1 Comprehension test results

The hypothetical situation employed in the key battery is not simple. We need to make sure that the respondents understand the assumptions made in the hypothetical situation—regarding cognitive decline, who will be making financial decisions, what they can do with their money, etc.—before they answer the questions. For this purpose, we implemented a set of comprehension test questions after presenting the hypothetical situation and before we asked the main questions. There were six test questions asked to all the respondents.[9] If the respondents do not get the full score in the first round, they will get a second opportunity to get the missed questions right after reviewing the related information. Panel A of Table C1 presents the distribution of scores out of the six questions that are asked to all the respondents after the first and the second round. The respondents did fairly well, even in the first round. Both the median and the average scores were four out of six. The majority of the respondents got the full score after the second round. This confirms that, though the situation assumed in the key battery is complex, the respondents overall did not have a problem in understanding it.

We also examine whether the response patterns are different depending on whether they fully understood the hypothetical situation or not. In Panel B of Table C1, we tabulate the distribution of the welfare cost of the transfer at the wrong time, separately for those who got the full score after the second round and those who did not. We find that, for both a delayed transfer and an early transfer, those who got the full score report a much larger welfare cost. In particular, reporting a negative welfare cost is much rarer among those who got the full score. Another pattern to note is that the share of respondents who are more concerned about an early transfer than about a delayed transfer is larger among those who did not get the full score (44%, compared to 34% among those who got the full score). So overall,

[9] Coupled respondents are asked one more question regarding whether the spouse/partner is alive in the hypothetical situation.

Table C1: Comprehension test results

A. Comprehension test score (full score = 6)

	10p	25p	50p	75p	90p	Mean	N
First round	2	3	4	5	6	3.9	2,489
Second round	4	5	6	6	6	5.5	2,489

B. Welfare cost (in % of W) of the transfer at the wrong time by test score

1) Full score after the second round

	10p	25p	50p	75p	90p	Mean	N
Delayed transfer	0	1.0	19.8	34.2	57.4	19.9	1,101
Early transfer	-35.2	0	16.8	29.2	55.2	11.5	570

2) Less than full score after the second round

	10p	25p	50p	75p	90p	Mean	N
Delayed transfer	-40.6	0	12.4	31.5	51.0	11.8	364
Early transfer	-49.0	-2.0	6.9	24.3	51.0	6.6	289

misunderstanding of the hypothetical situation, if anything, results in under-reporting of the welfare cost of the transfer at the wrong time, in particular that of a delayed transfer.

C2 Correlation with agent characteristics

The welfare cost of the transfer at the wrong time may depend on the agent characteristics. In particular, if the agent is close to the respondent, or if the agent is of higher quality, transferring control to the agent too early could be of less concern. In this subsection, we examine this hypothesis.

About 70% of the respondents chose a child as their likely agent (Table 1). Compared to other types of agents—a sibling and a trustee/an institution are the next most chosen options—a child is arguably the agent with the strongest interest in the well-being of the respondent and hence can be viewed more reliable. Table C2, Panel A shows that the fraction of those who are more concerned about an early transfer is indeed higher for a non-child agent (41%) compared to a child agent (35%). Table C2, Panel A also shows a similar pattern by the quality of the agent. In classifying the agents by their quality, we first convert the categorical responses to the quality of the agent reported in Table 1 (Panel B) into numerical responses (where Excellent is 5 while Poor is 1), calculate the median of the sum of the scores across the four dimensions asked, and then divide the agents into two groups depending on

whether the score is above or below the median. As expected, those with a lower quality agent are more likely to be more concerned about an early transfer (41%) than the other group (34%). The differences by the agent type and the agent quality are both statistically significant at the 1% level.

Table C2: Correlation with agent characteristics

A. Concerned more with ...

1) By agent type

	a delayed transfer	**an early transfer**	**N**
A child	64.8%	35.2%	1,617
Not a child	59.1%	40.9%	706

2) By quality

	a delayed transfer	**an early transfer**	**N**
$\geq$ median	66.5%	33.5%	1,176
$<$ median	59.5%	40.5%	1,147

B. Welfare cost (in % of W) of an early transfer

1) By agent type

	10p	**25p**	**50p**	**75p**	**90p**	**Mean**	**N**
A child	-49.5	-3.5	11.1	25.3	50.5	6.3	570
Not a child	-19.8	0	17.8	33.7	58.0	16.9	289

2) By agent quality

	10p	**25p**	**50p**	**75p**	**90p**	**Mean**	**N**
$\geq$ median	-49.0	-9.9	6.7	24.8	52.5	5.9	394
$<$ median	-29.2	0	17.3	28.7	55.5	13.2	465

The agent type and quality are also correlated with the perceived welfare cost of an early transfer (Table C2, Panel B). The median and mean of the welfare cost of an early transfer are about two times larger for those with a non-child agent or a lower quality agent compared to the complement groups. These sensible correlation patterns with the responses to factual questions give more credibility to the responses from the questions that employ the hypothetical situation.

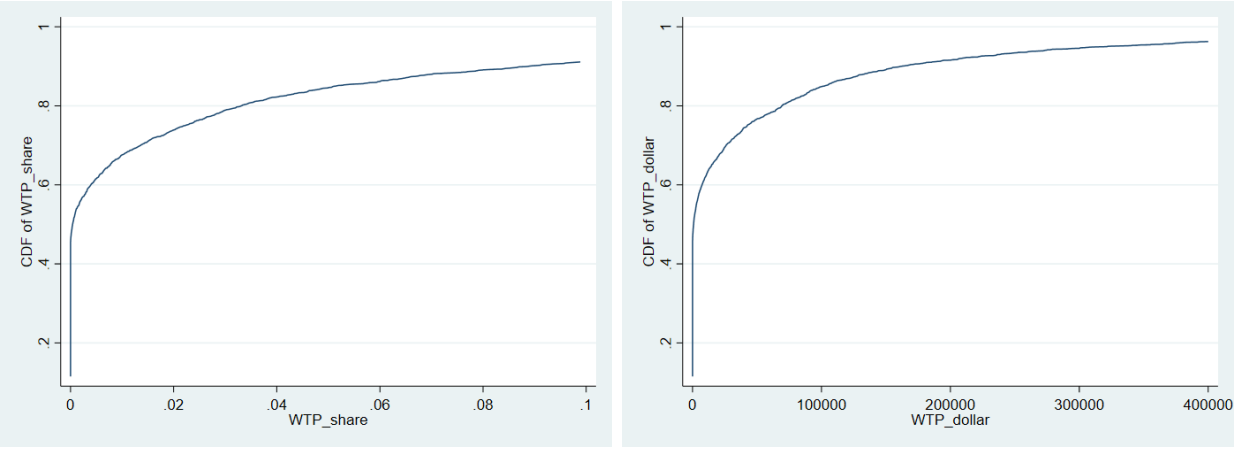
D Additional results on ex ante willingness to pay

D1 CDF of ex ante willingness to pay

Figure D1 reports the full CDF of ex ante willingness to pay discussed in Section IIE.

Figure D1: CDF of the WTP to guarantee the optimal timing of the transfer

(a) WTP in a fraction of wealth (b) WTP in dollars



Note: The vertical axis shows the CDF that corresponds to the value on the horizontal axis.

D2 Decomposition of variation in ex ante willingness to pay

This appendix examines how the distribution of ex ante willingness to pay (WTP) to guarantee the optimal timing of the transfer of control, reported in Section IIE, changes when we remove the heterogeneity in each of the factors in the WTP calculation (equation (3)). This exercise sheds light on the role of each factor in shaping the observed WTP distribution.

Table D1 reports the results. Panel A is for the WTP expressed as a fraction of wealth while Panel B is for the WTP in dollars. In each panel, the first row reports the baseline results with full heterogeneity (corresponding to Figure 1). Then in the following lines, we turn off heterogeneity in each of the following variables by replacing it by its average:

- The chance of having cognitive decline for at least five years (π_{CD}).
- The chance of having the transfer at the wrong time conditional on having cognitive decline (π_{WT}).
- The welfare cost of transfer at the wrong time conditional on having cognitive decline ($\hat{x}$).

- The marginal value of resources when cognitively declined (assuming the optimal timing of the transfer) compared to that when not cognitively declined ($\bar{V}'(W)/V'(W)$)).[10]

For the WTP in dollars, we also examine the role of heterogeneity in wealth ($\$W$).

Table D1: Decomposition of variation in ex ante willingness to pay

A. WTP as a fraction of wealth

	% with WTP>0	Average WTP	Std. Dev. of WTP
Full heterogeneity	55.0	1.9%	8.1%
No heterogeneity in π_{CD}	63.6	2.1%	8.6%
No heterogeneity in π_{WT}	55.0	1.6%	5.7%
No heterogeneity in $\hat{x}$	80.4	1.8%	2.5%
No heterogeneity in $\bar{V}'/V'$	55.0	1.9%	7.4%

B. WTP in dollars

	% with WTP>0	Average WTP	Std. Dev. of WTP
Full heterogeneity	55.0	\$47,434	\$210,372
No heterogeneity in π_{CD}	63.6	\$52,736	\$246,276
No heterogeneity in π_{WT}	55.0	\$39,618	\$169,562
No heterogeneity in $\hat{x}$	80.4	\$45,138	\$146,643
No heterogeneity in $\bar{V}'/V'$	55.0	\$47,182	\$187,937
No heterogeneity in W	55.0	\$50,747	\$213,924

Notes: The first row in each panel reports the baseline results with the heterogeneity in all the factors in the WTP calculation. The following rows report the results when heterogeneity in each factor is turned off, by replacing the variable by its average value (for the ratio of marginal utilities, $\bar{V}'/V'$, we use the median instead of the average due to some extreme right-tail observations).

The first column shows how the fraction of respondents with a positive WTP changes as we remove the heterogeneity in each variable. This reveals which variables are responsible for generating a zero WTP. The most common reason for a zero WTP is that some people do not worry at all about having the transfer of control at the wrong time conditional on having cognitive decline (i.e., $\hat{x} = 0$). Once we replace this with the sample average of $\hat{x}$, the WTP is zero for less than 20% of the sample.[11] Some have a zero WTP because they

[10] For this variable, we use the median instead of the average due to some extreme right-tail observations.

[11] The reason why the heterogeneity in π_{WT} does not affect the fraction with a zero WTP is that we set $\hat{x}$ to be zero for those who think there is no chance to have the transfer at the wrong time. Therefore, even if we replace $\pi_{WT} = 0$ with its average, the WTP is still zero for them since $\hat{x}$ is zero. In that sense, the impact of $\hat{x}$ in the first column combines the effect of believing that the transfer will never happen at the

believe they are not going to experience cognitive decline. Replacing π_{CD} with its average reduces the fraction of the respondents with a zero WTP by 9 percentage points.

The second column reports how the heterogeneity in each variable affects the average WTP. This examines the possibility of skewed distributions of variables affecting the average WTP, given that the numerator of the WTP calculation is a multiplication of the four factors. This turns out not to be the case. The average WTP as a fraction of wealth is only moderately affected by removing the heterogeneity in each variable, with the largest change being 0.3 percentage points (by removing the heterogeneity in π_{WT}) from 1.9% in the baseline. For the average WTP in dollars, the largest change (when removing the heterogeneity in π_{WT}) is also less than 20% of the baseline average.

The last column examines which variable contributes the most to the variation in the WTP. The standard deviation in the WTP shrinks the most when $\hat{x}$ is assumed to be homogeneous, followed by π_{WT}. So the heterogeneity in the WTP is mainly driven by the heterogeneity in the respondents' concerns about the transfer at the wrong time conditional on having cognitive decline. Turning off the heterogeneity in π_{CD}, on the other hand, increases the standard deviation of the WTP. This is because, for those who think they are unlikely to have cognitive decline (i.e., π_{CD} being close to zero), even if their concerns conditional on having cognitive decline are large, their WTP is calculated to be small. When small values of π_{CD} are replaced by the average π_{CD}, their significant conditional concerns (large $\hat{x}$ and π_{WT}) are translated into large WTP.

wrong time ($\pi_{WT} = 0$) and the transfer happening at the wrong time will not be bad at all even if it happens ($\hat{x} = 0$ and $\pi_{WT} > 0$).

E Details of the quantitative exercise using the model of unnoticed cognitive decline and suboptimal transfer of control

This appendix presents the details of the quantitative exercise we implement using the model of unnoticed cognitive decline and subobtimal transfer of control. The purpose of this exercise is to illustrate that the model is able to generate a likely and costly transfer at the wrong time under the calibration that is consistent with the survey evidence.

We calibrate the model to be consistent with key survey response patterns. The number of periods (T) is set to be five mirroring the hypothetical situation from the survey. The cognitive state space is set to be $\{\theta^1, \cdots, \theta^4\} = \{0.99, 0.95, 0.90, 0.80\}$. Under mild cognitive decline ($\theta^1 = 0.99$), the chance of making a financial mistake is limited ($0.01 = 1 - 0.99$), while it increases at a faster pace with the progression of cognitive decline. The transition probabilities are $\pi(\theta^j|\theta^j) = 0.7$ and $\pi(\theta^{j+1}|\theta^j) = 0.3$; there is a 70% chance cognitive ability remains constant and a 30% chance it worsens by one step. This process creates substantial potential uncertainty about cognitive ability. The probability of learning the cognitive state, ζ, is 30%. This parameter is calibrated such that the chance of not noticing own cognitive decline around the optimal timing of the transfer from the model is close to the subjective expectations from the survey.

We use a CRRA utility function, $U(x) = \frac{x^{1-\sigma}}{1-\sigma} + 2$, with $\sigma = 2$. We normalize $\bar{x}$ to be 1 ($U(\bar{x}) = 1$). We assume that when a financial mistake happens, it is disastrous: $\underline{x} = 0.04$ ($U(\underline{x}) = -25$), to create a large welfare cost of a delayed transfer.[12] The choice made by the agent is not far from the optimal: $x^A = 0.87$ ($U(x^A) = 0.85$) consistent with the respondents' view that the agent is high quality. To generate that the individual does not give up control immediately at θ^1 notwithstanding the high quality of the agent and the high cost of a financial mistake, the utility costs of using the agent when capable need to be large. We set $D(\boldsymbol{\lambda}_t) = \sum_j \lambda_{t,j} d(\theta_j)$ with $d(\theta_1) = 1.5$, $d(\theta_2) = 0.7$, and $d(\theta_3) = d(\theta_4) = 0$.[13] Note that large utility costs while capable are necessary implication of key patterns from the

[12] The assumed impact of the financial mistake may look large. Note that, under the calibrated model, this mistake is very rare, happening in only 5% of simulations, as the individual often transfers control before this happens or is lucky enough not to make a mistake when the declined individual is still in control. Note also that a financial mistake in this model can be interpreted as any event that commits one to a path of lower utility, including not only a loss of money (due to fraud, exploitation, or investment mistakes) but also other types of decisions that are hard to reverse, such as committing to a less desirable long-term-care arrangement or to a less desirable path of bequest and inter-vivos transfers.

[13] In terms of consumption equivalence, $d(\theta_1) = 1.5$ is equivalent to reducing the quality of consumption chosen by the agent from 0.87 ($= x^A$) to 0.38, while $d(\theta_2) = 0.7$ is to reduce it to 0.54.

survey—delayed transfers are perceived to be costly but individuals do not eliminate that risk by transferring control at the onset of cognitive decline—and the need for large costs while capable is robust with respect to alternative calibration of other parameters.

Under this calibration, the optimal timing of transfer determined under perfect information is as soon as cognitive decline reaches θ^2.[14] This is consistent with the vast majority of the sample not wanting to transfer immediately at the onset of cognitive decline but also not wanting to wait until completely losing their ability to manage. Under imperfect learning, however, it is possible that individuals do not have a good idea of their actual cognitive state even when the trigger for the optimal timing of transfer has been reached. Indeed, according to the simulations, the chance of "not noticing" the true value of θ_t—which we define as $\lambda_{t,j} < 0.5$ when $\theta_t = \theta^j$—when θ^2 is reached is 40% (the mean subjective probability of a similarly defined event from the survey is 42%; see Section IIC). As a result, individuals may delay transfer compared to the optimal timing. In the model, the chance of a delayed transfer, defined as not transferring control when at θ^2, happens to 35% of the individuals. The average subjective probability of a delayed transfer from the survey was also 35% (see Section IIC). When a delayed transfer happens, it is costly. The average utility difference between transferring at the optimal time and at a delay is equivalent to reducing consumption under the optimal transfer by 15%. This is close to the average welfare cost (17.9%) reported in the survey (see Section IID).

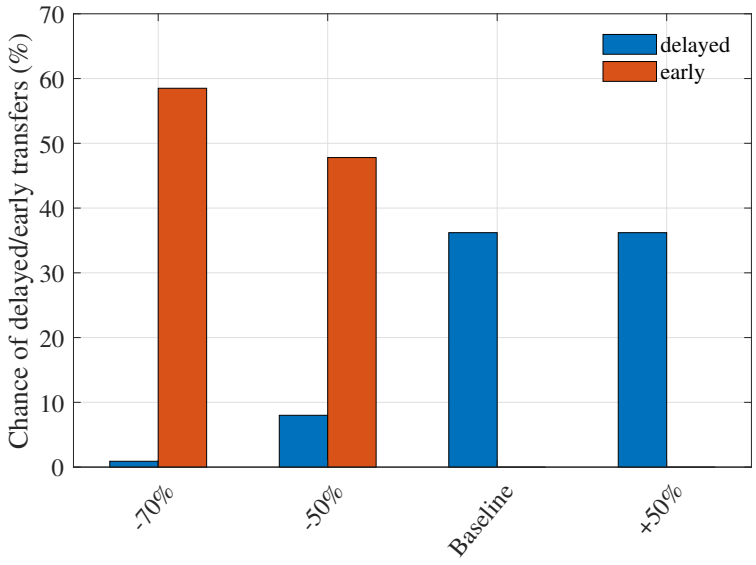
The above calibration does not generate a transfer that happens before the optimal timing. But a small change in the calibration creates such a possibility. For example, when we reduce the utility costs of using the agent, by changing $d(\theta_1)$ from 1.5 to 1.25 and $d(\theta_2)$ from 0.7 to 0.4, it does not change the optimal timing of the transfer, but with a significant chance (48%) the actual transfer under imperfect learning is too early compared to the optimal timing (the average subjective probability of this event in the survey is 24%). The average welfare cost of an early transfer is equivalent to reducing consumption under the optimal transfer by 6%, similar to the average cost (9.9%) reported in the survey (see Section IID).

Figure E1 sheds more light on the mechanisms of the model by illustrating how the chance of delayed and early transfers varies with the key model parameters: the utility cost of using the agent when capable ($D(\boldsymbol{\lambda}_t)$) and the probability of learning the cognitive state (ζ). Panel (a) plots the frequency of early and delayed transfers for different values of the utility costs of using the agent, holding other parameters at their baseline values. When $D(\boldsymbol{\lambda}_t)$ is reduced from its baseline value, it is no longer too costly to preempt financial

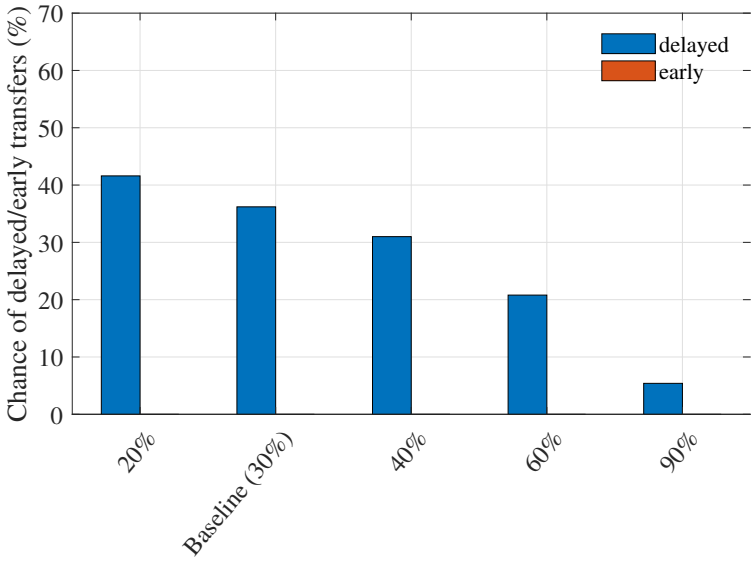
[14] For $t = 4$, the trigger is reaching θ^3, as there is less chance of making a financial mistake with fewer periods left. At $t = 5$, control will not be transferred.

mistakes by choosing an early transfer, so individuals often do so. A delayed transfer rarely happens with lower costs of using the agent. On the other hand, when $D(\boldsymbol{\lambda}_t)$ is as large as in the baseline calibration, an early transfer never happens. Panel (b) shows that the chance of a delayed transfer monotonically decreases with the probability of learning own cognitive status. The more likely it is that the individuals are aware of own cognitive state, the more likely they are to transfer control at the optimal timing. Together, these figures establish the importance of two key frictions—limited awareness of cognitive decline and utility costs of using the agent when capable—in generating delayed transfers.

Figure E1: Effects of the key model parameters on the chance of delayed and early transfers



(a) Changes in the utility costs of using the agent, $D(\boldsymbol{\lambda}_t)$



(b) Changes in the chance of learning cognitive status, ζ

Note: In Panel (b), the chance of an early transfer is zero in all the specifications considered.

References

Ameriks, John, Andrew Caplin, Minjoon Lee, Matthew D. Shapiro, and Christopher Tonetti. 2014. "Vanguard Research Initiative: Survey 1 Documentation and Tabulation." *Vanguard Research Initiative Reports and Documentation.*

Ameriks, John, Joseph Briggs, Andrew Caplin, Matthew D. Shapiro, and Christopher Tonetti. 2020. "Long-Term-Care Utility and Late-in-Life Saving." *Journal of Political Economy*, 128: 2375–2451.

Brown, Jeffrey R., Gopi Shah Goda, and Kathleen McGarry. 2016. "Heterogeneity in State-Dependent Utility: Evidence from Strategic Surveys." *Economic Inquiry*, 54: 847–861.

Health and Retirement Study. 2019. "HRS Core Public Use Dataset (2002-2016)." *University of Michigan [producer, distributor].*

Health and Retirement Study. 2021. "RAND HRS Longitudinal File." *University of Michigan [producer, distributor].*

Vanguard Research Initiative. 2020. "Vanguard Research Initiative Survey 7." *Vanguard Research Initiative [producer].*