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

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#### Abstract

Cognitive decline may lead older Americans to make poor financial decisions. Preventing poor decisions may require timely transfer of financial control to a reliable agent. Cognitive decline, however, can develop unnoticed, creating the possibility of suboptimal timing of the transfer of control. This paper presents survey-based evidence that older Americans with significant wealth regard suboptimal timing of the transfer of control, in particular delay due to unnoticed cognitive decline, as a substantial risk to financial well-being. This paper provides a theoretical framework to model such a lack of awareness and the resulting welfare loss.

Keywords: Cognitive Decline, Agency, Financial Decisionmaking, Transfer of Control

#### JEL Classification numbers: D14, E21, G51, G53

With population aging and the shift from defined-benefit to defined-contribution pensions, older Americans are becoming more responsible for managing their own finances during their retirement (Poterba, 2014). As they approach the end of their lives many have to make consequential financial decisions, such as estate planning, whether and when to sell their houses, and making costly late-in-life care arrangements. Unfortunately, cognitive decline may affect

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the quality of such decisions. About one-third of Americans 85 years or older (and 9 percent of those 65 years or older) have dementia (Langa et al., 2017) and cognitive decline without dementia is even more common (Plassman et al., 2008). Cognitive decline also makes older Americans vulnerable to financial fraud.<sup>1</sup> Setting up contingency plans can help with these challenges, but it is infeasible to plan for all potential paths of physical and cognitive health, longevity, financial and family dynamics. Therefore, as Agarwal et al. (2009), Santucci (2019), and Chandra, Coile and Mommaerts (2020) emphasize, it is important for economists to understand how Americans currently handle these challenges and to search for better paths forward. The prospect of cognitive decline makes the financial decisionmaker's ability focal for financial well-being in late life.<sup>2</sup>

Given that it is not possible to set in place complete contingent plans, the second best may involve relying on a third party ("agent" hereafter), commonly a family member, to take over decisions when cognitive decline has set in (see Angrisani and Lee, 2019). Ideally, this solution reduces the risk of making big mistakes. But even if there is a highly trusted agent, e.g., an adult child, there is another clear challenge that may limit their role. Many who have watched loved ones age are struck by their failure to recognize their own decline. The risk of unrecognized cognitive decline and its consequences are a salient part of the aging process. These concerns are precisely what we measure and model in this paper.

We use a survey to identify how many older American wealthholders have a reliable agent and how many are concerned about the timing of their likely transfer of control. We implement this instrument in the Vanguard Research Initiative (VRI), a panel of older (55+) Vanguard clients with above-average wealth and financial literacy. VRI coverage concentrates on individuals who have wealth above the age-adjusted U.S. population median wealth level. The 10th and 50th percentiles of the VRI wealth distribution correspond to the 60th and 90th percentiles of the U.S. population distribution.

The focus of the instrument was influenced by a pilot survey that affected our prior beliefs. Somewhat to our surprise, most respondents in the pilot survey were confident of the availability and ability of a trustworthy agent to make good financial decisions on their behalf—though not quite as good as decisions respondents themselves would make in the absence of cognitive decline. In contrast, many were concerned about their own future behavior and the possibility that they may fail to transfer control at the right time. This

<sup>&</sup>lt;sup>1</sup>DeLiema et al. (2020) documents financial fraud aimed at older Americans and Choi, Kulick and Mayer (2008) studies financial exploitation of elders. Egan, Matvos and Seru (2019) shows that there is more misconduct by financial advisers in counties with a larger population share of retirees.

<sup>&</sup>lt;sup>2</sup>See, for example, De Nardi, French and Jones (2010), Ameriks et al. (2011), Kopecky and Koreshkova (2014), Lockwood (2018), and Ameriks et al. (2020*b*), for studies that focus on the needs and desires of the older population, but not changes in their ability to make financial decisions. See De Nardi, French and Jones (2016) for a survey of this literature.

sophisticated understanding of future control problems was striking. Our main survey was designed to quantify concerns about both the quality of an available agent and about the timing of the transfer of control.

Despite the high quality of the agent, most respondents do not want to transfer control immediately at the onset of cognitive decline, implying value in being one's own agent while still capable. At the same time, this creates uncertainty about the timing of the transfer of control. In line with the pilot survey results, many respondents worry about a delayed transfer (compared to the optimal timing) of control. For those who worry, the subjective costs that we assess using a purpose-designed strategic survey question are perceived to be high, amounting to 18 percent of their wealth (about \$400,000) on average. The survey responses also allow us to calculate how much the respondents are currently willing to pay—without knowing whether they will develop significant cognitive decline or not—to guarantee the optimal timing of a transfer. Though willingness to pay (WTP) varies substantially across respondents, we identify many individuals with a high WTP: 25% of the sample would be willing to pay more than \$50,000, and 15% more than \$100,000, to guarantee the optimal transfer timing.

We develop a simple model of cognitive decline to capture the chance of not noticing own cognitive decline and how it limits the role of the agent. The model allows the actual timing of transfer either to be delayed by lack of awareness or to be earlier than ideal to preempt the risk of future lack of awareness. To highlight which features of the world might generate the concern evident in the survey responses, we implement an illustrative calibration exercise. The simple model is able to generate key findings from the survey: Delayed transfer is likely and costly. Essential to generating these results are limited awareness of cognitive decline and a desire to maintain control of one's own finances while capable.

This paper relates to an expanding literature on late-in-life financial mistakes. This literature investigates how cognitive decline is related to mistakes in using financial products (Agarwal et al., 2009), investment mistakes (Korniotis and Kumar, 2011), stock market participation (Christelis, Jappelli and Padula, 2010), wealth loss (Angrisani and Lee, 2019), and seeking financial advice (Kim, Maurer and Mitchell, 2019). See also Lusardi, Mitchell and Curto (2014) and Lusardi and Mitchell (2014), which document that financial literacy decreases with age late in life. We contribute to this literature by focusing on the role of a timely transfer of control over finances to a reliable agent in preventing late-in-life financial mistakes.

This paper also contributes to the literature on unnoticed cognitive decline. There are recent papers in the gerontology literature documenting unnoticed cognitive-decline-induced deterioration in general functioning (Farias, Mungas and Jagust, 2005, Okonkwo et al., 2009) and financial decision-making (Okonkwo et al., 2008, Nicholas et al., 2021, Sunderaraman et al., forthcoming). In the economics literature, Finke, Howe and Huston (2016), Gamble et al. (2015), and Mazzonna and Peracchi (2020) document the gap between self-confidence and objective performance in memory and financial literacy among older individuals. Mazzonna and Peracchi (2020) shows that this gap leads to a decline in wealth. We show that older individuals anticipate the possibility of not noticing their own decline and perceive this as a key friction in determining the timing of a transfer of control.

### I Data

This paper uses the Vanguard Research Initiative (VRI), a panel of account holders at the Vanguard Group. The VRI is composed of account holders who are at least 55 years old, have at least \$10,000 in their Vanguard accounts (to guarantee their nontrivial engagement with Vanguard), and have internet access enabling them to complete online surveys. The VRI consists of seven surveys and linked Vanguard account data. The sample design of the VRI provides ample observations of older Americans with a significant amount of wealth late in life, allowing for precise inference on questions that are relevant for that group.

The VRI surveys feature strategic survey questions (SSQs) that place the respondents in hypothetical situations and elicit their preferred actions in those situations. The SSQs enable identification of the role of individual preferences and beliefs, separately from confounding factors, in explaining observed behaviors. Multiple, purpose-designed VRI surveys have been used to study late-in-life saving (Ameriks et al., 2020b), the desire to insure long-term care risk (Ameriks et al., 2018), portfolio choice (Ameriks et al., 2020a), and retirement decisions (Ameriks et al., 2020c).

This paper uses the seventh VRI survey, which focuses on late-in-life cognitive decline. It was implemented over two phases. The pilot survey, implemented in December 2019, was fielded to a smaller sample (279 respondents) and focuses on the quality of the likely agents. It was followed up by online chats with respondents to learn more about their concerns related to their potential cognitive decline. The main survey, implemented in July 2020, was fielded to a larger sample (2,489 respondents) and focuses more on the timing of the transfer of control, a key concern identified in the pilot survey and the follow-up chats.<sup>3</sup> All the results reported in this paper are from the main survey unless noted otherwise.

Appendix A1 presents the key characteristics of the VRI sample. The mean age is 74

 $<sup>^{3}</sup>$ For the questions that are common between the pilot and main surveys, including the subjective probability of having cognitive decline and the quality of likely agents, the response distributions are almost identical between the two surveys.

years, with 80% of the sample aged 64 to 83. The VRI sample is, by construction, wealthier, more educated, and healthier than the Health and Retirement Study (HRS) sample that is representative of older Americans. A large part of the difference comes from the VRI sampling criteria (having at least \$10,000 in non-transactional accounts and internet access). Once we impose the same selection criteria on the HRS, the gap reduces significantly though not entirely. 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. See Appendix A1 for more details.

Given the sample characteristics, this is arguably a group of people for whom lack of financial knowledge is not a key issue for their financial well-being. This helps us focus on their concerns about losing current financial capability due to cognitive decline. Also, wealthholders need to make particularly complex financial decisions at the end of life (such as estate planning and arranging late-in-life care out of pocket). Wealthholders also face a higher chance of being a target of financial exploitation (DeLiema et al., 2020). In addition, Mazzonna and Peracchi (2020) documents that wealth decline after unnoticed cognitive decline is concentrated among wealthy individuals who hold stocks.

### **II** Survey evidence

In this section, we present the key survey findings on cognitive decline and the transfer of control.

#### A Subjective probability of cognitive decline

The survey follows the HRS by defining cognitive decline as having significant difficulties with any of the following: remembering familiar things and recent changes; learning new things; following a story in a book or on TV; making decisions on everyday matters; handling financial matters; using your intelligence to reason things through. It asks the subjective probability of having cognitive decline for at least one year and for at least five years.

The respondents overall perceive a meaningful risk of experiencing cognitive decline for at least five years. The median probability is 15% and the mean is 29%. The average subjective probability is somewhat smaller than, but fairly close to, the 34% realized average chance of having cognitive decline for at least five years calculated from the realized path of cognitive decline from the HRS sample that satisfy the VRI sampling criteria (see Appendix A2). The responses are also broadly similar to the subjective probability of dementia that Guistinelli, Manski and Molinari (2022) estimate from an experimental module in the HRS.

#### **B** Quality and availability of the agent

The survey then asks about the "likely agent" ("agent," henceforth)—the most likely person to make financial decisions on behalf of the respondent in case the respondent's ability to make a financial decision is severely impaired. For coupled households, the survey specifies that they outlived their spouse or partner by the time they have significant cognitive decline, so the spouse or partner cannot be the agent. The vast majority (70%) of the respondents say the agent is one of their children (Table 1, Panel A). About 10% say it is one of their siblings. The remaining 20% report something else.

Table 1: Agents: type, quality, and availability

#### A. Who is your likely agent?

	<u>Fraction</u>
Child/child-in-law	69.8%
Sibling	9.7%
Trustee/institution	8.7%
Grandchild	0.6%
Other	11.1%

#### B. How good would your likely agent be at ...

	Excellent	Very good	Good	Fair	Poor
Understanding your needs and desires	44%	39%	14%	3%	1%
Understanding your financial situation	48%	33%	15%	3%	0%
Understanding financial matters in general	48%	32%	15%	4%	0%
Pursuing your interests instead of his/her own	57%	30%	10%	2%	1%

#### C. Percent chance that your likely agent will be available

10p	$25\mathrm{p}$	$50\mathrm{p}$	75p	<b>90</b> p	Mean
25	55	85	100	100	76

Source: VRI Survey 7 as explained in text. Notes: N=2,489.

> Respondents are highly confident in the capability and trustworthiness of their agents. The vast majority of respondents believe that their agents would be either excellent or very good along many key criteria (Table 1, Panel B). The pilot survey also asks respondents to compare the quality of decisions made by either the agent or the self with cognitive decline to that of the self without cognitive decline. The respondents typically think the quality of decisions to be made by the agent is almost, though not exactly, as good as the self without

cognitive decline.<sup>4</sup>

The respondents are also confident their agent would be available, with an average subjective probability of availability when help is needed of 76% (Table 1, Panel C).

#### C Uncertainty in the timing of the transfer of control

The evidence presented so far suggests older American wealthholders are confident in the availability and quality of their agent. The online chats conducted after the pilot survey, however, indicated that the respondents are concerned about the possibility that control over their finances may not be transferred to the agent at the right time. Based on these findings, in the main survey, we designed a battery of questions to learn more about this concern.

The battery asks respondents about a hypothetical late-in-life situation with cognitive decline. (See Appendix B2 for the script of this battery.) Specifically, the respondents are asked to imagine that they are at the beginning of the last five years of their life and that they have mild cognitive decline. The progression of cognitive decline during the rest of the five years is left uncertain. Over the last five years of life, decisions need to be made about how to spend resources on the respondent's behalf (both routine and non-routine spending, including medical expenditures), how to save for the future and manage investments, and how much to give to relatives, friends, and charities. Those decisions can be made by the respondent, or by the agent if the respondent decides to transfer control to the agent (and if the agent agrees to it). The survey is concrete about the amount of financial resources available at the beginning of the last five years, W. It pre-loads an amount based on the actual net worth of the household.<sup>5</sup>

The battery first asks when is the optimal timing of the transfer, in terms of the progression of cognitive decline. In this question, the survey asks respondents to think only about the quality of financial decisions to be made and not to think about, for example, how much burden it will be to their agents. It presents three options listed in Panel A of Table 2. The vast majority (84%) say they do not want to give up control immediately at the onset of cognitive decline, implying that they value being their own agent when they are still capable, but also do not want to wait until they completely lose the ability to manage their own finances. This is consistent with the responses from the pilot survey that the agents are slightly worse than self without cognitive decline in terms of quality of decisions to be made, while the self with cognitive decline is the worst decisionmaker by a big margin.

<sup>&</sup>lt;sup>4</sup>The question asks the amount of wealth needed to compensate for decisions to be made by the worse decisionmaker. See Appendix B1 for the implementation of this question and the details of the responses.

<sup>&</sup>lt;sup>5</sup>The survey uses the nearest multiple of \$500,000 to respondents' actual net worth. If net worth is below \$250,000, it uses \$500,000. See Appendix Table B2 for the distribution of W.

#### A. Optimal timing of transfer

	<b>Fraction</b>
Immediately at the onset of cognitive decline	8.0%
During further decline, but before completely losing the ability to manage own finances	83.9%
When completely lose the ability to manage own finances	8.1%

#### B. Transfer at the wrong time

	Distribution of percent chance						
	10p	25p	50p	75p	90p	Mean	$\mathbf{N}$
Delayed transfer	5	15	25	55	75	35	2,293
Early transfer	5	5	25	35	35	24	$2,\!295$
C. Reasons for a delayed transfer							
	Dis	stribu	tion o	f perc	ent cl	nance	
	10p	$25\mathrm{p}$	$50\mathrm{p}$	$75\mathrm{p}$	90p	Mean	$\mathbf{N}$
Respondent not noticing own cognitive decline	15	25	45	55	75	42	2,293
Respondent not wanting to give up the control	5	25	45	65	75	44	2,293
Agent not noticing principal's cognitive decline	5	15	25	55	75	33	$2,\!293$
Agent not being available	0	5	15	35	55	23	$2,\!293$
D. Reasons for an early transfer							

	Dis	nance					
	10p	25p	50p	75p	90p	Mean	$\mathbf{N}$
Agent taking control against respondent's preference	5	5	25	35	55	26	2,294

Source: VRI Survey 7 as explained in text.

Notes: N=2,489 for Panel A. The numbers of observations are smaller for the other panels as the questions related to a delayed transfer are not asked to respondents who choose the last option in the optimal timing question while the questions related to an early transfer are not asked to respondents who choose the first option in the optimal timing question.

Then the battery asks how likely it is that the actual timing of the transfer will be different from the optimal timing. The actual timing can be either too late or too early compared to the optimal timing. The average subjective probability of having a delayed transfer is 35% (Table 2, Panel B). A delayed transfer may happen for various reasons, including those listed in Panel C. The respondents are particularly worried that they might not notice their own decline and that they, once declined, might refuse to give up control. The average subjective probability of an early transfer is 24% (Panel B), slightly less likely than a delayed transfer. One potential reason for an early transfer is the agent taking control

earlier than the respondent wants, which is seen similarly likely as an early transfer (Panel D).

#### D Welfare cost of mistimed transfer of control

How damaging would it be if the transfer of control happens at the wrong time? For those who assign a positive probability for both a delayed and an early transfer, the survey first asks which is the greater concern. To keep the structure simple, the survey branches to learn more only about that event.<sup>6</sup> More than half of the respondents (1,465 respondents) are more concerned about a delayed transfer, while 859 respondents are more concerned about a nearly transfer.

The survey asks the respondents to compare the following two scenarios. If a respondent takes the delayed-transfer branch, the scenarios are:

- Scenario 1: The transfer of control happens at the optimal timing.
- Scenario 2: The transfer of control is delayed compared to the optimal timing.

Scenario 2 does not specify the timing of the delayed transfer. Respondents are asked to imagine the most likely outcome conditional on it being delayed. (The same approach was taken for an early transfer.) To quantify the welfare cost of transferring at the wrong time compared to the optimal time, the survey asks for the amount of additional wealth needed for the respondent to be indifferent between the two scenarios. In other words, we measure the value of  $\hat{x}$  that satisfies

(1) 
$$\bar{\nu}(W) = \hat{\nu}([1+\hat{x}]W),$$

where  $\bar{\nu}$  is the utility from the last five years of life under optimal transfer timing and  $\hat{\nu}$  that under wrong timing.

Table 3 shows that, overall, the respondents believe that a transfer at the wrong time can be very costly. For a delayed transfer, respondents on average require a wealth compensation of 18% of their financial resources (or \$432K). Early transfer is less costly, but the compensation required is not small, averaging 10% of wealth (or \$245K).

There is strong heterogeneity across respondents in the cost of transferring at the wrong time. More than one-quarter of the sample, in both the delayed-transfer and the early-

 $<sup>^{6}</sup>$ For the respondents who assign a positive probability to only one event, the survey branches to that event. For those who assign a zero probability to both events (6% of the sample), this part of the survey is skipped.

Table 3:	Welfare	$\operatorname{cost}$	of	transfer	$\operatorname{at}$	the	wrong	time
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A. Welfare cost of a delayed transfer											
	10p	$25\mathrm{p}$	50p	75p	90p	Mean	$\mathbf{N}$				
Percent of wealth	-10.4	0	19.3	34.1	56.4	17.9	1,465				
\$1,000s	-126	0	290	646	1,248	432	1,465				
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<b>D.</b> Wenare cost	or an e	early i		er	00	ъл	ът				
	10p	25p	50p	75p	90p	Mean	IN				
Percent of wealth	-39.6	0	13.4	27.2	54.5	9.9	859				
Percent of wealth \$1,000s	-39.6 -698	0 0	13.4 188	27.2 520	54.5 1,213	$9.9 \\ 245$	859 859				

Source: VRI Survey 7 as explained in text.

Notes: The compensating variation in wealth is expressed as a fraction of wealth (first row) or in dollars (second row).

transfer branches, believe that a transfer at the wrong time will not be costly at all.<sup>7</sup> On the other hand, more than a quarter of the sample report a substantial amount of compensation needed—larger than 34% of wealth in the delayed-transfer case and larger than 27% in the early-transfer case.

Appendix C provides further evidence, including results from comprehension test questions and correlations between concerns about transferring at the wrong time and agent characteristics. This evidence suggests that the survey responses are credible.

### E Ex ante willingness to pay to guarantee the optimal timing of the transfer of control

The survey evidence we reported shows that, *conditional on* having cognitive decline in the future, the transfer of control over finances at the wrong time is perceived to worsen financial well-being significantly. That does not imply that the respondents, who do not currently have cognitive decline, are very concerned about this issue. In this section, we quantify respondents' current concern about mistiming the transfer of financial control. We show how responses to survey questions can be combined to measure the willingness to pay (WTP) to guarantee the optimal timing of transfer. The WTP is measured using an

<sup>&</sup>lt;sup>7</sup>Slightly more than 10% of the sample in the delayed-transfer branch and about 15% of the sample in the early-transfer branch report a negative value of compensation needed. Appendix C1 shows that negative welfare costs are much rarer, and the average welfare costs are much larger, among the sample who have a better understanding of the hypothetical situation according to the survey comprehension test result. Hence, the negative welfare numbers are likely to be survey response errors and the averages reported in Table 3 are likely to be attenuated due to survey response errors.

expected utility framework, but imposes no further assumptions. In Section III, we present a theoretical model that investigates which frictions can generate a costly suboptimal time of transfer.

Specifically, we consider the hypothetical scenario in which respondents are at the beginning of the last five years of their life. They do not know whether or not they will have cognitive decline.<sup>8</sup> We consider the hypothetical intervention that guarantees the optimal timing of the transfer (in the case cognitive decline develops) and compute the WTP for such an intervention. Let P be the WTP measured as a fraction of wealth. It satisfies

(2) 
$$(1 - \pi_{CD})\nu(W) + \pi_{CD}(1 - \pi_{WT})\bar{\nu}(W) + \pi_{CD}\pi_{WT}\hat{\nu}(W) = (1 - \pi_{CD})\nu((1 - P)W) + \pi_{CD}\bar{\nu}((1 - P)W),$$

where  $\nu$  is the utility from the last five years of life under no cognitive decline, while  $\bar{\nu}$  and  $\hat{\nu}$  are that under cognitive decline with the optimal and suboptimal timing of the transfer.  $\pi_{CD}$  is the subjective probability of having cognitive decline and  $\pi_{WT}$  is the probability the transfer of control occurs at the wrong time conditional on having cognitive decline. The left-hand-side is expected life-time utility accounting for uncertainty in the timing of the transfer. The right-hand-side is the expected life-time utility after paying a fraction of wealth to guarantee the optimal timing of the transfer.

The first-order Taylor polynomial of equation (2) around P = 0 and  $\hat{x} = 0$  (and using equation (1))<sup>9</sup> yields the following WTP approximation:

(3) 
$$P = \frac{\hat{x}\pi_{CD}\pi_{WT}(\bar{\nu}'(W)/\nu'(W))}{(1-\pi_{CD})+\pi_{CD}(\bar{\nu}'(W)/\nu'(W))},$$

where  $\hat{x}$  is the conditional welfare cost from equation (1). Equation (3) shows that the WTP positively depends on four factors. While we do not have measures of all variables in equation (2), our survey measures each of these factors in equation (3) for each individual:

- 1. The chance of having cognitive decline for at least five years ( $\pi_{CD}$ , reported in Appendix Table A4).<sup>10</sup>
- 2. The chance the transfer is made at the wrong time conditional on having cognitive

<sup>&</sup>lt;sup>8</sup>We abstract from the time they have until they reach the last five years of their life. This simplification may not be too consequential given the high average age (74) of respondents.

<sup>&</sup>lt;sup>9</sup>See Figure 1 for values of P and Table 3 for values of  $\hat{x}$ .

<sup>&</sup>lt;sup>10</sup>For the coupled respondents, we define this as the joint probability of having cognitive decline and outliving spouse/partner (asked in the survey), assuming independence between the two events. Assuming a sensible correlation between the two probabilities—e.g., using the larger probability between the two, since the two events are likely to be positively correlated—does not change the result significantly.

decline ( $\pi_{WT}$ , reported in Table 2).

- 3. The welfare cost of transferring at the wrong time conditional on having cognitive decline  $(\hat{x}, \text{ reported in Table 3})$ .
- 4. The marginal value of wealth when cognitively declined (assuming the optimal timing of the transfer) compared to that when not cognitively declined  $(\bar{\nu}'(W)/\nu'(W))$ . To measure this last value, the survey asks another hypothetical question where the respondent faces uncertainty about having cognitive decline based on the strategy from Ameriks et al. (2020*b*). The respondent allocates resources between two lockboxes where the money in one lockbox can be used only if the respondent develops cognitive decline while the other can be used only if not. See Appendix B3 for the details of this survey question and the distribution of the responses.

Figure 1, Panel (a) presents the distribution of the WTP (as a fraction of wealth, computed using equation (3)) across respondents.<sup>11</sup> There is considerable heterogeneity in the WTP. About 45% of the sample have zero WTP. This is not surprising because the WTP is zero as long as one of the four factors mentioned above is zero.<sup>12</sup> Many of those who have a positive WTP have quite a large WTP. More than a quarter of the sample are willing to pay more than 2% of their wealth; More than 15% are willing to pay more than 5% of their wealth. Given that the money spent to guarantee the optimal timing of the transfer is wasted unless they end up having cognitive decline, this is a fairly large WTP. In terms of dollar amount, these are large: About a quarter of the sample are willing to pay more than \$50,000; more than 15% are willing to pay more than \$100,000 (Panel (b)).<sup>13</sup> This result indicates that there are large potential welfare gains from measures or policies that help address transfer timing uncertainty.

# III Model of unnoticed cognitive decline and suboptimal transfer of control

In this section, we present a model of cognitive decline. Instead of aiming to capture the full complexity of cognitive decline and transfer of control, we develop a very simple model that accounts for the key findings from the survey. The chief novelty is that individuals

<sup>&</sup>lt;sup>11</sup>See Appendix Figure D1 for the WTP CDFs.

<sup>&</sup>lt;sup>12</sup>Appendix D2 examines how each factor contributes to the WTP distribution.

<sup>&</sup>lt;sup>13</sup>Note that this might be an underestimate of the WTP because, in calculating the WTP, we only take into account the possibility of either a delayed transfer or an early transfer, based on what most concerns them, not both.





Source: VRI Survey 7 as explained in text.

may be unaware of their cognitive decline. The model shows the importance of this friction in generating suboptimal timing of transfer and welfare-reducing financial mistakes. The model also reveals the need for a large (potentially utility) cost of using an agent when not experiencing severe cognitive decline to explain why many older individuals remain exposed to these risks.<sup>14</sup>

We model an individual who will live for T periods. Each period, the individual may or may not learn her cognitive status. The individual not only needs to make a consumption decision out of the available choice set, but also a financial decision that may affect the choice set available in the future. A bad financial decision irreversibly reduces the choice set and hence damages welfare. Cognitive decline increases the probability of a bad financial decision such as being a victim of financial fraud. To avoid making a bad financial decision, the individual can transfer control to an agent, who would make both consumption and financial decisions for the remaining periods. The agent will not make a financial mistake, though the consumption choice made by the agent will not perfectly align with the individual's preference. Not being fully aware of her own cognitive decline may lead to suboptimal timing of the transfer of control.

To be specific,  $\theta_t$  is the individual's cognitive ability in period t, which will be parame-

<sup>&</sup>lt;sup>14</sup>Kim, Maurer and Mitchell (2016) develops a life-cycle model where individuals decide on financial management delegation facing a time cost of management and age-dependent decisionmaking abilities. Different from theirs, our model focuses on the possibility of unnoticed cognitive decline and uncertainty in the timing of the transfer of control caused by that friction.

terized in terms of the odds of a bad financial decision. Higher  $\theta_t$  represents higher cognitive ability (and lower chance of making a bad financial decision).  $\theta_t$  takes values  $\{\theta^1, \dots, \theta^N\}$ , where  $\theta^1 > \theta^2 > \dots > \theta^N$ . In the first period,  $\theta_1 = \theta^1$ , where  $\theta^1$  represents mild cognitive decline. Modeling a fixed number of years of remaining life and starting with mild cognitive decline is consistent with the hypothetical situation in the survey. Each period, cognitive ability either stays the same or declines. It evolves according to a first-order Markov process, where  $\pi(\theta^j | \theta^m)$  specifies the probability of having  $\theta^j$  in the next period given the current ability  $\theta^m$ .

The individual's consumption preference in each period is represented by  $U(\cdot)$ . For simplicity, we assume zero time discount rate. In each period, if no financial mistake has been made previously, there are three options available in the choice set  $X = \{\bar{x}, x^A, \underline{x}\}$ , where  $\bar{x}$  is the first-best choice,  $x^A$  is the second-best and is chosen by the agent, and  $\underline{x}$  is what the individual will be forced to choose after a financial mistake as explained below. Preference is such that  $U(\bar{x}) > U(x^A) >> U(\underline{x})$ , so the individual will always choose  $\bar{x}$  if it is in the choice set.

At the end of each period, if no financial mistake has been made previously, the individual also makes a financial decision. There are good (G) and bad (B) financial decisions. If G is chosen, the choice set remains intact in the next period. If B is chosen, the choice set becomes  $X_B = \{\underline{x}\}$ , so the individual will be forced to choose the worst option for the remaining periods. The chance of choosing B is  $1 - \theta_t$ , so the more cognitively declined the individual is, the more likely she is to make a financial mistake. Thus, we focus on modeling cognitive decline's effect on financial decisions, which affects utility through restricting the choice set.

Knowing that she might make a bad financial decision, the individual contemplates handing over control based on her beliefs about her cognitive status. The key to the model is the prior awareness of her possible lack of future awareness of this state. Formally,  $\lambda_{t,j}$  is the probability that  $\theta_t = \theta^j$  and  $\lambda_t$  is the probability vector at time t. The individual may or may not learn  $\theta_t$  at the beginning of each period. Learning happens with probability  $\zeta$ . If learning happens,  $\lambda_t$  has probability one for the true state. If learning does not happen, Bayesian updating implies that

(4) 
$$\lambda_{t,j} = \frac{\sum_{m=1}^{N} \pi(\theta^j | \theta^m) \chi^m \lambda_{t-1,m}}{\sum_{k=1}^{N} \sum_{m=1}^{N} \pi(\theta^k | \theta^m) \chi^m \lambda_{t-1,m}}$$

where  $\chi^m = (1 - \theta^m)$  if a financial mistake occurred in t - 1 and  $\chi^m = \theta^m$  if no mistake was made. Given the prior  $\lambda_{t-1}$ , the denominator is the probability of the realized financial outcome in t - 1 occurring and the numerator is the probability of that financial outcome occurring and  $\theta_t = \theta^j$ . Essentially, the individual updates their prior about  $\theta_{t-1}$  after observing the financial outcome and then uses the transition matrix  $\pi$  to update from  $\theta_{t-1}$ to  $\theta_t$ . Thus, an individual may be unaware she is suffering from severe cognitive decline after several periods of not learning her cognitive ability and not making a financial mistake.

Since the individual knows ex ante the risk of self-damage due to unawareness of decline, this factors into the only remaining decision, which is when to hand over control should no mistake have been made as yet. To capture imperfect agency, the agent chooses  $x^A$ , which is between the best  $(\bar{x})$  and the worst  $(\underline{x})$  options, if the choice set is still intact. The agent does not make financial mistakes. Therefore, the individual faces a trade-off in using the agent: The agent's choice would be worse than the first-best option, but the agent will allow the individual to avoid the worst option.

Survey responses reveal that, even though the agent's decision is perceived to be high quality (i.e.,  $U(x^A)$  is close to  $U(\bar{x})$ ), respondents are unlikely to transfer control immediately at the onset of cognitive decline. Hence, they value being in control while they are still capable. To account for this, we assume a per-period utility cost of using the agent that increases as a function of perceived cognitive ability,  $D(\lambda_t)$ . This cost captures disutility from being a burden or losing independence while still capable and is unrelated to the quality of the agent.<sup>15</sup>

The timeline of the model is as follows. The individual enters each period with beliefs  $\lambda_{t-1}$ , a choice set  $X_t$  that is X or  $X_B$ , and either in control or having transferred control. Transfer of control is an absorbing state. In period t:

- 1. The individual learns  $\theta_t$  with probability  $\zeta$  and updates beliefs  $\lambda_t$
- 2. If in control, the individual chooses whether to maintain control or transfer control
- 3. The person in control chooses consumption from  $X_t$  and makes a financial decision that determines  $X_{t+1}$

Let  $V_t^A(\boldsymbol{\lambda}_t)$  be the value when the agent makes decisions in period t and  $X_t = X$ :

(5) 
$$V_t^A(\boldsymbol{\lambda}_t) = U(x^A) - D(\boldsymbol{\lambda}_t) + E_t[V_{t+1}^A(\boldsymbol{\lambda}_{t+1})|\boldsymbol{\lambda}_t].$$

Let  $V_t(\lambda_t)$  be the value of entering period t in control when  $X_t = X$ , which is the larger

 $<sup>^{15}</sup>$ For evidence on burden aversion in the context of late-in-life care provision see Cahill et al. (2009) and Delgado-Guay, Cruz and Epner (2013).

value of either transferring or maintaining control this period:

(6)

$$V_t(\boldsymbol{\lambda}_t) = \max\left\{V_t^A(\boldsymbol{\lambda}_t), U(\bar{x}) + \sum_{j=1}^N [\lambda_{t,j}(1-\theta^j)](T-t)U(\underline{x}) + \sum_{j=1}^N [\lambda_{t,j}\theta^j]E_t[V_{t+1}(\boldsymbol{\lambda}_{t+1})|\boldsymbol{\lambda}_t]\right\}.$$

The value of maintaining control has three components: utility from consuming  $\bar{x}$ , the perceived chance of making a financial mistake today and consuming  $\underline{x}$  for periods t + 1 to T, and the perceived chance of not making a mistake today and entering t + 1 in control with  $X_{t+1} = X$ . Control is transferred if and only if  $V_t^A(\lambda_t) = V_t(\lambda_t)$ .

The optimal timing of the transfer of control is defined as the timing chosen under the counterfactual case of  $\zeta = 1$ , i.e., under perfect information, where  $\lambda_t$  has probability one for the true state in every period. The timing determined under imperfect information can deviate from optimal, in particular when  $\lambda_t$  does not assign a large enough probability to the true state. Unawareness of ongoing cognitive decline may delay the transfer of control. If the individual becomes too preemptive anticipating this possibility, on the other hand, she will suffer a loss of utility from both the agent's selection of the second-best option and the direct utility cost from loss of control.

We implement a quantitative exercise based on an illustrative calibration to the survey evidence to show that this simple framework can generate a likely and costly transfer at the wrong time. This exercise is illustrative in purpose, as the model abstracts from many other ways cognitive decline can affect the individual. Here we report an overview of the calibration with details presented in Appendix E. We set  $x^A$  to be close to  $\bar{x}$  to capture the perceived high quality of the agent, as reported in the survey (Appendix B1). We set  $\underline{x}$  to be very small (i.e., a financial mistake is disastrous) to match the large welfare cost of a delayed transfer. We calibrate  $\zeta$  to match the subjective probability of not noticing own decline around the optimal timing of the transfer. We set parameters of the cognitive decline process to create substantial potential uncertainty about cognitive decline. Lastly, to explain the key patterns from the survey—delayed transfers are perceived to be costly but individuals do not eliminate that risk by transferring control at the onset of cognitive decline—we set  $D(\lambda_t)$  to be large when  $\theta$  is likely to be high.

Under the baseline calibration reported in Appendix E, the model generates a 36% chance of delayed transfer. When delay happens, it is costly: The average welfare cost is equivalent to reducing consumption by 15%. These match closely the corresponding averages from the survey (35% and 18%). There is a 41% chance the individual does not notice her own decline around the optimal timing of the transfer, close to the 42% average in the survey. Though the baseline calibration does not generate a transfer that happens before the optimal timing, a small change in the calibration, reducing the utility costs of using the agent for example, creates such a possibility.<sup>16</sup> Therefore, this illustrative exercise, combined with the survey responses, suggests the importance of incorporating limited awareness of cognitive decline and the desire to maintain control of one's own finances while capable into studies of late-in-life cognitive decline and financial decisionmaking.

### IV Conclusion

Having a reliable agent can go a long way towards protecting one from poor financial decisions induced by cognitive decline in late life. It could, however, be challenging to transfer control over finances to the agent at the right level of cognitive decline due to, among other reasons, limited awareness of the severity of cognitive decline. A desire to be one's own agent while still capable increases this risk. We provide a theoretical framework that demonstrates that this particular aspect of cognitive decline can significantly limit the helpfulness of an agent. We present evidence from the purpose-designed survey that reveals this transfer-timing issue to be a serious concern for many older American wealthholders.

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<sup>&</sup>lt;sup>16</sup>An alternative way to generate early transfers would be to allow for taking back control after a transfer was made, which we do not explore here. Appendix E documents how the likelihood of delayed and early transfers varies with the utility cost of using the agent and the probability of learning own cognitive status.

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# 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 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.<sup>1</sup> 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.

			Age	and Wealth		
	10p	$25\mathrm{p}$	$50\mathrm{p}$	$75\mathrm{p}$	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	$1,\!630,\!000$	$2,\!923,\!623$	$2,\!401,\!415$	
	Mar	ried		]		
	$\frac{\mathbf{Yes}}{65\%}$	<u>No</u> 35%		$\frac{< \text{College}}{24\%}$	$\frac{\text{College}}{33\%}$	$\frac{> \text{College}}{43\%}$
	Se	ex			Health	
	<u>Female</u> 32%	$rac{\mathbf{Male}}{68\%}$		$\frac{\mathbf{Excellent}/}{\frac{\mathbf{Very} \ \mathbf{Good}}{67\%}}$	$\frac{\textbf{Good}}{26\%}$	Fair/ <u>Poor</u> 7%

Table A1: VRI sample characteristics

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.

<sup>&</sup>lt;sup>1</sup>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 (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.<sup>2</sup> Table A3

 $<sup>^2\</sup>mathrm{A}$  small fraction of those invited to Survey 7 did not complete Survey 5. They are not included in this analysis.

A. Age-eligible HRS			Age	e and Wealth				
	10p	$25\mathrm{p}$	$50\mathrm{p}$	$75\mathrm{p}$	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		
	Mar	ried	_	Educ	ation			
	Yes	No		< College	> College			
	$\overline{51\%}$	$\overline{49\%}$		69%	$\frac{-31\%}{-31\%}$			
	Sex				Health			
				Excellent/		Fair/		
	Female	Male		Very Good	Good Poor			
	52%	48%		39%	35%	$\overline{26\%}$		
B. VRI-eligible HRS			Age	e and Wealth				
	10p	$25\mathrm{p}$	$50\mathrm{p}$	$75\mathrm{p}$	90p	Mean		
Age	60	63	67	73	79	68		
Financial wealth	54,065	$124,\!350$	$330,\!878$	850,824	1,701,968	$750,\!047$		
Net worth	155,707	308,711	646,618	1,387,309	2,703,743	$1,\!270,\!059$		
	Mar	ried	_	Educ	ation			
	Yes	No		< College	$\geq$ College			
	$\overline{67\%}$	$\overline{33\%}$		47%	53%			
	Se	ex	_		Health			
				Excellent/		Fair/		
	Female	Male		Very Good	Good	$\mathbf{Poor}'$		
	44%	56%		55%	$\overline{32\%}$	12%		

#### Table A2: HRS sample characteristics

Notes: The table uses financial respondents in the HRS 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.

	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

Table A3: Sample characteristics by participation in Survey 7

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).

A. All	10p	$25\mathrm{p}$	$50\mathrm{p}$	$75\mathrm{p}$	90p	Mean	Ν
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	$25\mathrm{p}$	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

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

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.

A. By age group	10p	$25\mathrm{p}$	$50\mathrm{p}$	$75\mathrm{p}$	90p	Mean	$\mathbf{N}$
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	10p	$25\mathrm{p}$	50p	75p	90p	Mean	N
B. Whether have an issue in dealing with money	10p	25p	50p	75p	90p	Mean	Ν
B. Whether have an issue in dealing with money Yes	<b>10</b> p 19	<b>25</b> p 22	<b>50p</b> 25	<b>75</b> p 27	<b>90p</b> 29	Mean 24.3	N 24,066

Table A5: Cognitive ability score distribution in the HRS

Notes: This table tabulates the distribution of the cognitive ability scores (RxCOGTOT in the RAND version) from the VRI-eligible HRS sample (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 (selfreported 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.

	$25\mathrm{p}$	$50\mathrm{p}$	$75\mathrm{p}$	Mean	$\mathbf{N}$
VRI-subjective	5	15	45	29	$2,\!489$
HRS-realized	34	37	39	34	$2,\!489$

Table A6: Subjective versus realized probability of having cognitive decline

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.<sup>3</sup> 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:

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

 $<sup>^3 {\</sup>rm The}$  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  $\nu_S$  is the utility from the last five years of life with the self without cognitive decline as the decisionmaker and  $\nu_A$  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 decision makers compared to the self without cognitive decline: measured in compensating variation in wealth (in % of wealth)

<b>Decisionmaker</b>	10p	$25\mathrm{p}$	$50\mathrm{p}$	$75\mathrm{p}$	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"<sup>4</sup>) would be in making spending and saving decisions for you, if you have cognitive decline. To standardize the questions across respondents, we present a **hypothet**-ical 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:

<sup>&</sup>lt;sup>4</sup>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.<sup>5</sup>

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

	$10\mathrm{p}$	$25\mathrm{p}$	$50\mathrm{p}$	$75\mathrm{p}$	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**:

<sup>&</sup>lt;sup>5</sup>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"<sup>6</sup>

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

<sup>&</sup>lt;sup>6</sup>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<sup>7</sup>

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.

<sup>&</sup>lt;sup>7</sup>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?<sup>8</sup>

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.]

<sup>&</sup>lt;sup>8</sup>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,  $\overline{W}$ . 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:

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

such that:

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

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  $\nu$  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):

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

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

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

We set  $\theta$ , 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,  $\eta$  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

	$25\mathrm{p}$	$50\mathrm{p}$	$75\mathrm{p}$	Mean	Ν
$W_{CD}/W$ :	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.<sup>9</sup> 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,

<sup>&</sup>lt;sup>9</sup>Coupled respondents are asked one more question regarding whether the spouse/partner is alive in the hypothetical situation.

A. Comprehension test score (full score $= 6$ )								
	10p	$25\mathrm{p}$	$50\mathrm{p}$	75p	90p	Mean	$\mathbf{N}$	
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	$25\mathrm{p}$	$50\mathrm{p}$	75p	90p	Mean	$\mathbf{N}$		
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 fu	ll score 10p	e aftei 25p	r the s 50p	secono 75p	d rour 90p	nd Mean	Ν		
Delayed transfer	-40.6	0	12.4	31.5	51.0	11.8	364		

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 agen	t type		
	a delayed	an early	
	<u>transfer</u>	<u>transfer</u>	$\underline{\mathbf{N}}$
A child	64.8%	35.2%	$1,\!617$
Not a child	59.1%	40.9%	706

#### 2) By quality

	a delayed	an early	
	<u>transfer</u>	<u>transfer</u>	$\underline{\mathbf{N}}$
$\geq$ 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	$25\mathrm{p}$	50p	$75\mathrm{p}$	90p	Mean	$\mathbf{N}$		
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 agen	t qual 10p	ity 25p	50p	75p	90p	Mean	Ν		
$\geq$ 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





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  $(\pi_{CD})$ .
- The chance of having the transfer at the wrong time conditional on having cognitive decline  $(\pi_{WT})$ .
- 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  $(\bar{V}'(W)/V'(W)))$ .<sup>10</sup>

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

Table D1: Dec	composition	of	variation	in	ex a	ante	willingness	to	pay	V
							()			/

#### A. WTP as a fraction of wealth

	$\underline{\%}$ with WTP>0	Average WTP	Std. Dev. of WTP
Full heterogeneity	55.0	1.9%	8.1%
No heterogeneity in $\pi_{CD}$	63.6	2.1%	8.6%
No heterogeneity in $\pi_{WT}$	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

	$\underline{\% \text{ with WTP} > 0}$	Average WTP	Std. Dev. of WTP
Full heterogeneity	55.0	\$47,434	\$210,372
No heterogeneity in $\pi_{CD}$	63.6	\$52,736	\$246,276
No heterogeneity in $\pi_{WT}$	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.<sup>11</sup> Some have a zero WTP because they

<sup>&</sup>lt;sup>10</sup>For this variable, we use the median instead of the average due to some extreme right-tail observations.

<sup>&</sup>lt;sup>11</sup>The reason why the heterogeneity in  $\pi_{WT}$  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  $\pi_{CD}$  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  $\pi_{WT}$ ) from 1.9% in the baseline. For the average WTP in dollars, the largest change (when removing the heterogeneity in  $\pi_{WT}$ ) 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  $\pi_{WT}$ . 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  $\pi_{CD}$ , 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.,  $\pi_{CD}$  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  $\pi_{CD}$  are replaced by the average  $\pi_{CD}$ , their significant conditional concerns (large  $\hat{x}$  and  $\pi_{WT}$ ) 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  $\{\theta^1, \dots, \theta^4\} = \{0.99, 0.95, 0.90, 0.80\}$ . 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,  $\zeta$ , 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.<sup>12</sup> 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  $\theta^1$  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  $D(\lambda_t) = \sum_j \lambda_{t,j} d(\theta_j)$  with  $d(\theta_1) = 1.5$ ,  $d(\theta_2) = 0.7$ , and  $d(\theta_3) = d(\theta_4) = 0$ .<sup>13</sup> Note that large utility costs while capable are necessary implication of key patterns from the

<sup>&</sup>lt;sup>12</sup>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.

<sup>&</sup>lt;sup>13</sup>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  $\theta^{2,14}$ . 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  $\theta_t$ —which we define as  $\lambda_{t,j} < 0.5$  when  $\theta_t = \theta^j$ —when  $\theta^2$  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  $\theta^2$ , 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  $(D(\lambda_t))$  and the probability of learning the cognitive state  $(\zeta)$ . 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  $D(\lambda_t)$  is reduced from its baseline value, it is no longer too costly to preempt financial

<sup>&</sup>lt;sup>14</sup>For t = 4, the trigger is reaching  $\theta^3$ , 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  $D(\lambda_t)$  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

(b) Changes in the chance of learning cognitive status,  $\zeta$ 

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

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