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 wealthholders 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

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1 Introduction

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 choosing late-in-life care arrangements (which are often very costly). Unfortunately, cognitive decline may affect the quality of such decisions.[1] 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, as documented in academic papers as well as in media.[2] 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 emphasized for example in Agarwal et al. (2009) and Chandra, Coile and Mommaerts (2020), it is important for economists to understand how Americans currently handle these challenges and to search for better paths forward. A cognitive-decline perspective centers the financial decisionmaker's ability as an integral part of financial well-being in late life.[3]

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.[4]

[1]There is 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) that document decreasing financial literacy over age.

[2]DeLiema et al. (2020) documents financial frauds 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. For an example in popular media see https://www.theguardian.com/world/2021/apr/21/hong-kong-woman-90-conned-out-of-32m-in-phone-scam.

[3]See, for example, De Nardi, French and Jones (2010), Ameriks et al. (2011), Kopecky and Koreshkova (2014), Lockwood (2018), and Ameriks et al. (2020), 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.

[4]See Okonkwo et al. (2008), Finke, Howe and Huston (2016), and Nicholas et al. (2021) for evidence on unnoticed deterioration in financial skills and increasing financial mistakes such as missing payments before

They may understand that this could in future apply to them. 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. The focus of the instrument was influenced by a pilot survey which impacted 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. On the flip side many appeared concerned about their own future behavior and the possibility that they may fail to transfer control at the right time. 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, 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 the transfer. We identify a large group with a high willingness-to-pay (WTP): 25% of the sample would be willing to pay more than $50,000 and 15% more than $100,000 to guarantee the optimal timing of the transfer.

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. Our simple model is able to generate key findings from the survey: Delayed transfer is likely and costly.

2 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,

a dementia diagnosis.

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.

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 particular 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.[5] All the results reported in this paper are from the main survey unless noted otherwise.

Appendix Table A1 presents the key characteristics of the VRI sample who completed the main survey. The mean age is 74 years, with 80% of the sample being in the range from 64 to 83. The VRI sample is not representative of Americans in this age range by construction. They are wealthier (median financial wealth more than one million dollars), more educated (76% have a college degree), and healthier than the Health and Retirement Study (HRS) sample that is representative of older Americans (see Appendix A.1). 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 to the HRS sample, the gap reduces significantly though not entirely (Appendix Table A2, Panel B).

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).

3 Survey evidence

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

[5]For the questions that are common between the pilot and main surveys, the response distributions are almost identical between the two surveys.

3.1 Subjective probability of cognitive decline

The survey follows the HRS by defining cognitive decline as having significant difficulties in 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%, while 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 A.2).

3.2 Confidence in 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 likely 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.

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 (see Panel B of Table 1). 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.[6]

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).

[6] The question asks the amount of wealth needed to compensate for decisions to be made by the worse decisionmaker. See Appendix B.1 for the implementation of this question and the details of the responses.

Table 1: Agents: type, quality, and availability

A. Who is your likely agent?

	Fraction
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	25p	50p	75p	90p	Mean
	25	55	85	100	100	76

Notes: N=2,489.

3.3 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. On the other hand, the online chats conducted after the pilot survey indicated that the respondents are more concerned about the possibility that the control over finance 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 these concerns.

The battery asks respondents about a hypothetical late-in-life situation with cognitive decline. (See Appendix B.2 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 initially. 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 on 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 investment, 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.[7]

The battery first asks when respondents think the optimal timing of the transfer is, in terms of the progression of the 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 self with cognitive decline is the worst decisionmaker by a big margin.

Then the battery asks how likely the respondents think 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).

3.4 Transfer of control at the wrong time can be damaging

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 about that event only.[8] More than half of the respondents (1,465 respondents) are more concerned about a delayed transfer, while 859 respondents are more concerned about

[7]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 $\$W$.

[8]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 2: Uncertainty in the timing of the transfer of control

A. Optimal timing of transfer

	Fraction
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. Percent chance of transfer at the wrong time

	10p	25p	50p	75p	90p	Mean	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

Percent chance of ...	10p	25p	50p	75p	90p	Mean	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

Percent chance of ...	10p	25p	50p	75p	90p	Mean	N
Agent taking control against respondent's preference	5	5	25	35	55	26	2,294

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.

an early 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

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

where $\bar{V}$ is the value function under optimal transfer timing and $\hat{V}$ that under wrong time.

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).

Table 3: Welfare cost of transfer at the wrong time

A. Welfare cost of a delayed transfer							
	10p	**25p**	**50p**	**75p**	**90p**	**Mean**	**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
B. Welfare cost of an early transfer							
	10p	**25p**	**50p**	**75p**	**90p**	**Mean**	**N**
Percent of wealth	-39.6	0	13.4	27.2	54.5	9.9	859
$1,000s	-698	0	188	520	1,213	245	859

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

We also find that 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-transfer branches, believe that a transfer at the wrong time will not be costly at all, even if it happens.[9] On the other hand, more than a quarter of the sample report a substantial amount of compensation needed, which is larger than 34% of wealth in the delayed-transfer case and larger than 27% in the early-transfer case.

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

[9] 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 C.1 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.

3.5 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. To do so, we consider a hypothetical scenario in which respondents are at the beginning of the last five years of their life, without knowing whether they will have cognitive decline or not.[10] We consider a hypothetical intervention that guarantees the optimal timing of the transfer (in the case cognitive decline develops) and compute the willingness-to-pay (WTP) for such an intervention. The WTP, measured as a fraction of wealth, satisfies

$$\begin{aligned} &(1-\pi_{CD})V(W) + \pi_{CD}(1-\pi_{WT})\bar{V}(W) + \pi_{CD}\pi_{WT}\hat{V}(W) \\ &= (1-\pi_{CD})V((1-WTP)W) + \pi_{CD}\bar{V}((1-WTP)W), \end{aligned} \tag{2}$$

where V is the value function under no cognitive decline, while $\bar{V}$ and $\hat{V}$ are that under cognitive decline with the optimal and wrong timing of the transfer. π_{CD} is the subjective probability of having cognitive decline and π_{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, while the right-hand-side is the expected life-time utility after paying a fraction of wealth to guarantee the optimal timing of the transfer.

Under a first-order Talyor approximation, and combining the above equation with equation (1), the value of WTP that satisfies equation (2) is

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

where $\hat{x}$ is the conditional welfare cost from equation (1). Equation (3) shows that the WTP positively depends on four factors, all measured at the individual level from the survey:

- The chance of having cognitive decline for at least five years (π_{CD}, reported in Appendix Table A3).[11]

[10] 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.

[11] For the coupled respondents, we define this as the joint probability of having cognitive decline and

- The chance the transfer is made at the wrong time conditional on having cognitive decline (π_{WT}, reported in Table 2).

- The welfare cost of transfer at the wrong time conditional on having cognitive decline ($\hat{x}$, reported in Table 3).

- The marginal value of wealth when cognitively declined (assuming the optimal timing of the transfer) compared to that when not cognitively declined ($\bar{V}'(W)/V'(W)$)). To measure this, the survey asks another hypothetical question where the respondent faces uncertainty about having cognitive decline based on the strategy from Ameriks et al. (2020). 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 B.3 for the details of this survey question and the distribution of the responses.

Figure 1, Panel (a) presents the distribution of the estimated WTP (as a fraction of wealth) across respondents.[12] 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.[13] 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)).[14] This result indicates that there are large potential welfare gains with any measures or policies that help address the timing of the transfer uncertainty.

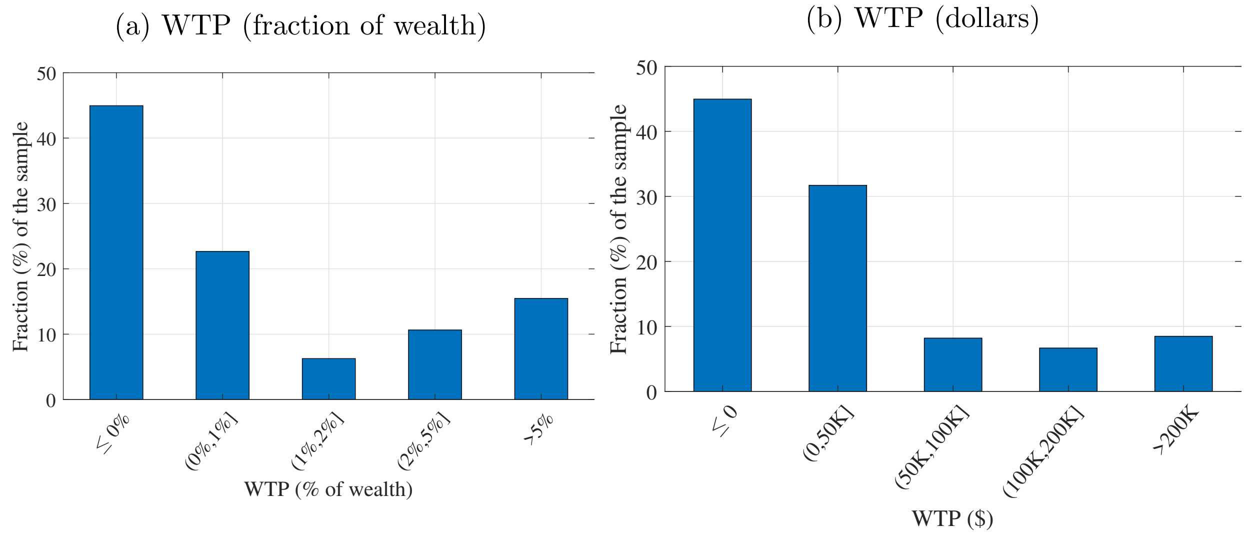
outliving spouse/partner (asked in the survey), assuming independence between the two events. Assuming a sensible correlation between the two probabilities—e.g., using the larger probability between the two, since the two events are likely to be positively correlated—does not change the result significantly.

[12] See Appendix Figure D1 for the WTP CDFs.

[13] Appendix D.2 examines how each factor contributes to the WTP distribution.

[14] 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.

Figure 1: Distribution of the WTP to guarantee the optimal timing of the transfer



4 Model of unnoticed cognitive decline and suboptimal transfer of control

In this section, we present a simple model of cognitive decline. Instead of aiming to capture the full complexity around cognitive decline and the transfer of control, we outline a very simple model that accounts for the key findings from the survey. The chief novelty is that individuals 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 (utility) cost of using an agent when not experiencing severe cognitive decline to explain why many older individuals remain exposed to these risks.

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, which may impact 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 may 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, θ_t is the individual's cognitive ability in period t, which will be parameterized in terms of the odds of a bad financial decision. Higher θ_t represents higher cognitive ability (and lower chance of making a bad financial decision). θ_t takes values $\{\theta^1, \cdots, \theta^N\}$, where $\theta^1 > \theta^2 > \cdots > \theta^N$. In the first period, $\theta_1 = \theta^1$, where θ^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 used in the survey. Cognitive ability evolves according to a non-increasing first-order Markov process, where $\pi_{\theta^j|\theta^i}$ specifies the probability of having θ^j in the next period given the current ability θ^i.

The individual's consumption preference in each period is represented by $U(\cdot)$. For simplicity, we assume no time discount. In each period, if no financial mistake has been made previously, there are three options available in the choice set $X = \{x^\star, x^A, \tilde{x}\}$, where $x^\star$ is the first-best choice, x^A is the second-best and is chosen by the agent, and $\tilde{x}$ is what the individual will be forced to choose after a financial mistake as explained below. Preference is such that $U(x^\star) > U(x^A) >> U(\tilde{x})$, so the individual will always choose $x^\star$ 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. We allow for 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 $X_B = \{\tilde{x}\}$, 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 they are to make a financial mistake. 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, the individual may or may not learn θ_t at the beginning of each period. Learning happens with probability ζ. If learning does not happen, Bayesian updating implies that

$$Pr(\theta_t = \theta^j) = \frac{\sum_m \pi(\theta^j|\theta^m)(1-(1-\theta^m))Pr(\theta_{t-1} = \theta^m)}{\sum_m \sum_k \pi(\theta^k|\theta^m)(1-(1-\theta^m))Pr(\theta_{t-1} = \theta^m)}, \tag{4}$$

where $(1 - (1 - \theta^m))$ is the chance of not making a financial mistake under θ^m. 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. Note that if the choice set is already reduced to X_B by a financial mistake, beliefs play no further role.

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 ($x^\star$) and the worst ($\tilde{x}$) 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 $U(x^\star)$), 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 utility cost of using the agent that increases as a function of cognitive ability, $D(\theta_t)$.[15] This cost captures disutility from being a burden or losing independence while still capable and is unrelated to the quality of the agent.[16]

Under the imperfect information ($\zeta < 1$), control is transferred if and only if

$$\begin{aligned} U(x^A) - D(\theta_t) + E_t[\tilde{V}^A_{t+1}(\boldsymbol{\lambda}_{t+1})|\boldsymbol{\lambda}_t] > & U(x^\star) + \sum_j [\lambda_{t,j}(1-\theta^j)] \sum_{t+1}^{T} U(\tilde{x}) + \\ & \sum_j [\lambda_{t,j}\theta^j] E_t[\tilde{V}_{t+1}(\boldsymbol{\lambda}_{t+1})|\boldsymbol{\lambda}_t], \end{aligned} \tag{5}$$

where $\lambda_{t,j}$ is the probability of having $\theta_t = \theta^j$ and $\boldsymbol{\lambda}_t$ the probability vector at time t. The left-hand-side is the expected utility from transferring control now (i.e., having x^A for the remaining periods minus utility cost of using the agent). $\tilde{V}^A_{t+1}(\theta_{t+1})$ is the continuation value after transferring control, i.e., the expected value of the left-hand-side in the next period. The right-hand-side is the expected utility from keeping control (i.e., having $x^\star$ for the current period but facing the risk of being forced to choose $\tilde{x}$ in the following periods). $\tilde{V}_{t+1}(\theta_{t+1})$ is the continuation value conditional on (i) the choice set being intact and (ii) the individual still having control, i.e., the expected value of the maximum of the left-hand-side and the right-hand-side in the next period.

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. In this case, the necessary and sufficient condition for using an agent is the same as (5) except that $\boldsymbol{\lambda}_t$ assigns probability one to the true state in every period.

[15] When the individual does not learn the current state, the cost is evaluated based on the subjective belief, i.e., $\sum_j D(\theta_j) Pr(\theta_t = \theta^j)$.

[16] 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).

The timing determined under imperfect information can deviate from optimal, in particular when $\boldsymbol{\lambda}_t$ 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.

Though this simple model abstracts from many other ways cognitive decline can affect the individual, we implement a quantitative exercise to show that this simple framework can account for key patterns from the survey. We calibrate the model to be consistent with key survey response patterns. The number of periods (T) is set to be five mirroring the hypothetical situation from the survey. The cognitive state space is set to be $\{\theta^1, \cdots, \theta^4\} = \{0.98, 0.85, 0.60, 0.20\}$. Under mild cognitive decline ($\theta^1 = 0.98$), the chance of making a financial mistake is limited ($0.02 = 1 - 0.98$), while it increases at a faster pace with the progression of cognitive decline. The transition probabilities are $\pi_{\theta^j|\theta^j} = 0.7$ and $\pi_{\theta^{j+1}|\theta^j} = 0.3$; there is a 70% chance cognitive ability remains constant and a 30% chance it worsens by one step. This process creates substantial potential uncertainty about cognitive ability. The probability of learning the cognitive state, ζ, is 30%. This parameter is calibrated such that the chance of not noticing own cognitive decline around the optimal timing of the transfer from the model is close to the subjective expectations from the survey.

We use a CRRA utility function, $U(x) = \frac{x^{1-\sigma}}{1-\sigma} + 2$, with $\sigma = 2$. We normalize $x^\star$ to be 1 ($U(x^\star) = 1$). We assume that when a financial mistake happens, it is disastrous: $\tilde{x} = 0.04$ ($U(\tilde{x}) = -25$), to create a large welfare cost of a delayed transfer.[17] The choice made by the agent is not far from the optimal: $x^A = 0.87$ ($U(x^A) = 0.85$), consistent with the respondents' view that the agent is high quality. To generate that the individual does not give up control immediately at θ^1 notwithstanding the high quality of the agent and the high cost of a financial mistake, the utility costs of using the agent when capable need to be large. We set them to be $D(\theta_1) = 1.5$, $D(\theta_2) = 0.7$, and $D(\theta_3) = D(\theta_4) = 0$.[18] Note that large utility costs while capable are necessary implication of key patterns from the survey—delayed transfers are perceived to be costly but individuals do not eliminate that risk by transferring control

[17] 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.

[18] 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.

at the onset of cognitive decline—and the need for large costs while capable is robust with respect to alternative calibration of other parameters.

Under this calibration, the optimal timing of transfer determined under perfect information is as soon as cognitive decline reaches θ^2.[19] This is consistent with the vast majority of the sample not wanting to transfer immediately at the onset of cognitive decline but also not wanting to wait until completely losing their ability to manage. Under imperfect learning, however, it is possible that individuals do not have a good idea of their actual cognitive state even when the trigger for the optimal timing of transfer has been reached. Indeed, according to the simulations, the chance of "not noticing" the true value of θ_t—which we define as $\lambda_{t,j} < 0.5$ when $\theta_t = \theta^j$—when θ^2 is reached is 40% (the mean subjective probability of a similarly defined event from the survey is 42%; see Section 3.3). As a result, individuals may delay transfer compared to the optimal timing. In the model, the chance of a delayed transfer, defined as not transferring control when at θ^2, happens to 35% of the individuals. The average subjective probability of a delayed transfer from the survey was also 35% (see Section 3.3). 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 3.4).

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 (47%) 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 3.4).

In short, this simple model that focuses on limited awareness of cognitive decline is able to account for the key concerns identified from the survey responses. There is uncertainty in the timing of transfer of control and a large cost of suboptimal timing. Though the quantitative exercise is illustrative in purpose, the results in this section, combined with the survey responses, suggest the importance of incorporating the limited awareness of cognitive decline in structural modeling and the desire to maintain control of one's own finances while capable when studying issues around late-in-life cognitive decline and financial decisionmaking.

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

5 Conclusion

Having a reliable agent can go a long way towards protecting one from poor financial decisions due to cognitive decline in late life. It could, however, be challenging to transfer the 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. In this paper, 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 on key factors surrounding this issue. We find that this transfer-timing issue is a serious concern for many older American wealthholders.

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

A.1 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.[20] By construction, the VRI sample is composed of wealthholders. The median and mean financial wealth are $1.2M and $1.9M; the median and mean net worth are $1.6M and $2.4M. The sample also has an overall high level of education: 76% have a college degree and 43% have a post-college degree. A majority of the sample (67%) report that they are in excellent or very good health. The VRI oversamples singles: About a third of the sample are singles.

Table A1: VRI sample characteristics

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

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

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

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

[20]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. 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.

A.2 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 A3 (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

Table A2: HRS sample characteristics

A. Age-eligible HRS

Age and Wealth

	10p	25p	50p	75p	90p	Mean
Age	60	63	69	76	84	70
Financial wealth	-1,946	11	41,630	301,683	902,886	353,526
Net worth	584	44,982	220,585	658,512	1,587,350	670,732

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

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

B. VRI-eligible HRS

Age and Wealth

	10p	25p	50p	75p	90p	Mean
Age	60	63	67	73	79	68
Financial wealth	52,983	124,350	330,878	850,824	1,697,642	766,635
Net worth	151,815	309,252	643,374	1,389,472	2,766,149	1,284,699

Married: Yes	Married: No	Education: < College	Education: ≥ College
68%	32%	47%	53%

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

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= 9,821 for Panel A and N=2,682 for Panel B. Financial wealth and net worth are in 2020 dollars.

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 A3, Panel B) are half as many again as those in the complement group (Table

A3, Panel C).

Table A3: Subjective probability of having cognitive decline in the VRI (%)

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

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

The HRS provides the cognitive ability score (RxCOGTOT in the RAND version) based on many tests, including word recall, number series, etc. It is unclear what level of this score can be used as a threshold for cognitive decline. To get a sense of this, in Table A4, 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 A4, we define cognitive decline as having a score lower than 20, because that satisfies those conditions. Less than 10% of the sample below age 70 have a score lower than 20, but the share increases significantly for higher ages, to close to 50% for those with 90+. A threshold value of 20 also produces the desired pattern in the data by whether they have an issue in dealing with money or not.

Table A4: Cognitive ability score distribution in the HRS

A. By age group	**10p**	**25p**	**50p**	**75p**	**90p**	**Mean**	**N**
50-59	20	23	25	27	29	24.9	3,758
60-69	20	23	25	27	29	25.0	8,077
70-79	19	22	24	27	28	23.9	10,250
80-89	16	19	22	25	27	21.9	2,999
90-	13	17	20	22	25	19.2	260

B. Whether have an issue in dealing with money	**10p**	**25p**	**50p**	**75p**	**90p**	**Mean**	**N**
Yes	19	22	25	27	29	24.3	24,632
No	10	16	20	24	27	19.4	475

Notes: This table tabulates the distribution of the cognitive ability scores (RxCOGTOT in the RAND version) from the VRI-eligible HRS sample (wage 2002-2016).

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

Table A5 compares the subjective probability reported in the VRI and the probability from the simulations described above. With the caveat that what the VRI respondents had in mind may not be the same as the threshold we used in defining cognitive decline in the HRS (the cognitive score being lower than 20), many VRI respondents turn out to be optimistic, under-estimating the chance of having cognitive decline. At the same time, there are a non-negligible fraction of respondents that report a high probability, making the average of the subjective expectation comparable to that of the realized probability.

Table A5: Subjective versus realized probability of having cognitive decline

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

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

B Details of the VRI cognitive decline survey

B.1 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 3.4 and in Appendix B.2, 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.[21] 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:

$$V_S(W) = V_A([1 + x_W]W), \tag{6}$$

where V_S is the value function with the self without cognitive decline as the decisionmaker and V_A is that with the agent as the decisionmaker. We repeat this question replacing the agent with the self with cognitive decline.

[21] 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.

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

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

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

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

B.2 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"[22]) would be in making spending and saving decisions for you, if you have cognitive decline. To standardize the questions across respondents, we present a* ***hypothetical situation*** *about your* ***age***, ***health***, *and* ***wealth***.

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

The ***hypothetical situation***:

- *You experience cognitive decline*
- *You have five years to live with this cognitive decline*

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

- *You have a fixed amount of resources equal to \$W to meet all your wants and needs for these five years.*[23]

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

Table B2: Distribution of resources assumed in the hypothetical situation

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

Notes: N=2,489.

[Change in the screen]

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

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

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

[Change in the screen]

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

- *You are* $max\{85, currentage + 10\}$ *years old.*

[23]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 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"[24]

*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

[24]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[25]

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.*

[25] 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]

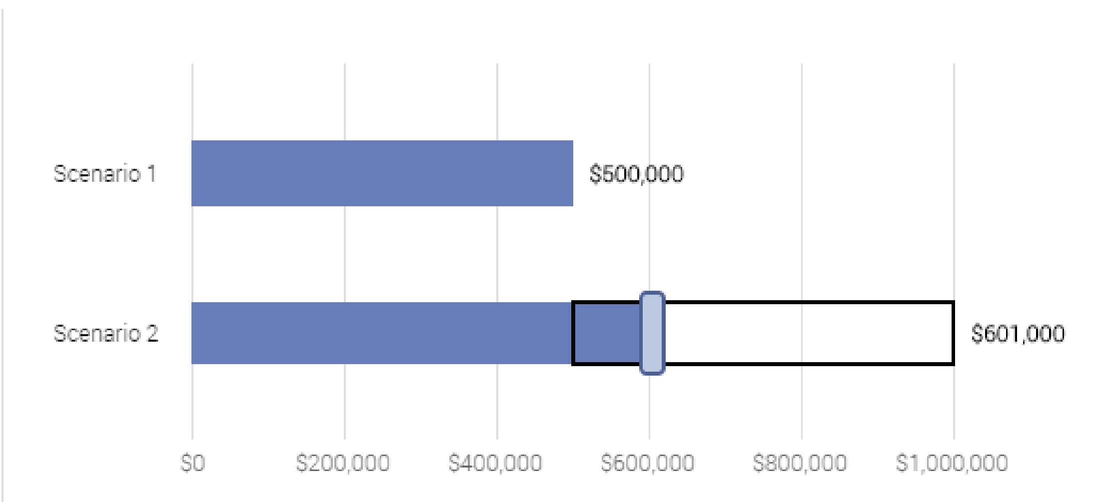
Q. Your previous response indicates that you would be better off with the spending and saving decisions made under ***Scenario 1*** *with $W in resources than those under* ***Scenario 2 (transfer delayed)*** *with $W in resources. Imagine, instead, that the resources available under* ***Scenario 2*** *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?*[26]

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 B2 is posited here.]

[26] 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 B2: Slider interface to measure compensating variation in wealth



B.3 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) and Brown, Goda and McGarry (2016), we ask the following strategic survey question (SSQ). The question assumes that the respondent is at the beginning of the last five years of her life. It further assumes that there is uncertainty in whether she will experience cognitive decline during these five years, as in the main question battery in this survey, or not. The chance of having cognitive decline is given as $\pi_{CD} = 25\%$. The respondent has a given amount of wealth, $\bar{W}$. The respondent is asked to allocate this wealth into two lockboxes, A and B. Each dollar invested in Lockbox A will give $1/\pi_{CD} = 4$ dollars only if the respondent turns out to have cognitive decline; It will give nothing if the respondent does not experience cognitive decline. Each dollar invested in Lockbox B will give one dollar if the respondent does not experience cognitive decline; Under cognitive decline, it will give nothing. The question assumes that the transfer of control will happen at the optimal timing, in case having cognitive decline.

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

$$\pi_{CD}\bar{V}(W_{CD}) + (1 - \pi_{CD})V(W_N), \tag{7}$$

such that:

$$W_{CD} = \frac{1}{\pi_{CD}}(\bar{W} - W_N). \tag{8}$$

where W_{CD} and W_N are resources with and without cognitive decline, $\bar{V}$ is the value function under cognitive decline (assuming the optimal timing of the transfer), and V is the value function under no cognitive decline. We parameterize the value functions based on Ameriks et al. (2020):

$$\bar{V}(W) = \eta^{\frac{1}{\theta}} \frac{W^{(1-\frac{1}{\theta})}}{1 - \frac{1}{\theta}}, V(W) = \frac{W^{(1-\frac{1}{\theta})}}{1 - \frac{1}{\theta}}, \tag{9}$$

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

$$\eta = \frac{W_{CD}}{W_N}(1 - \pi_{CD})^{\theta}. \tag{10}$$

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

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

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

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

C Credibility of responses

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

C.1 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.[27] 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,

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

Table C1: Comprehension test results

A. Comprehension test score (full score = 6)

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

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

1) Full score after the second round

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

2) Less than full score after the second round

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

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

C.2 Correlation with agent characteristics

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

About 70% of the respondents chose a child as their likely agent (Table 1). Compared to other types of agents—a sibling and a trustee/an institution are the next most chosen options—a child is arguably the agent with the strongest interest in the well-being of the respondent and hence can be viewed more reliable. Table C2, Panel A shows that the fraction of those who are more concerned about an early transfer is indeed higher for a non-child agent (41%) compared to a child agent (35%). Table C2, Panel A also shows a similar pattern by the quality of the agent. In classifying the agents by their quality, we first convert the categorical responses to the quality of the agent reported in Table 1 (Panel B) into numerical responses (where Excellent is 5 while Poor is 1), calculate the median of the sum of the scores across the four dimensions asked, and then divide the agents into two groups depending on whether the score is above or below the median. As expected, those with a lower quality agent are more likely to be more concerned about an early transfer (41%) than the other group (34%). The differences by the agent type and the agent quality are both statistically significant at the 1% level.

Table C2: Correlation with agent characteristics

A. Concerned more with ...

1) By agent type

	a delayed transfer	**an early transfer**	**N**
A child	64.8%	35.2%	1,618
Not a child	59.1%	40.9%	706

2) By quality

	a delayed transfer	**an early transfer**	**N**
$\geq$ median	66.5%	33.5%	1,176
$<$ median	59.5%	40.5%	1,148

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

1) By agent type

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

2) By agent quality

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

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

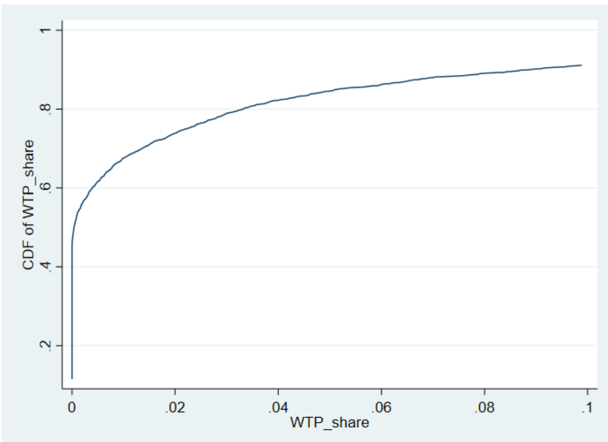
D Additional results on ex ante willingness-to-pay

D.1 CDF of ex ante willingness-to-pay

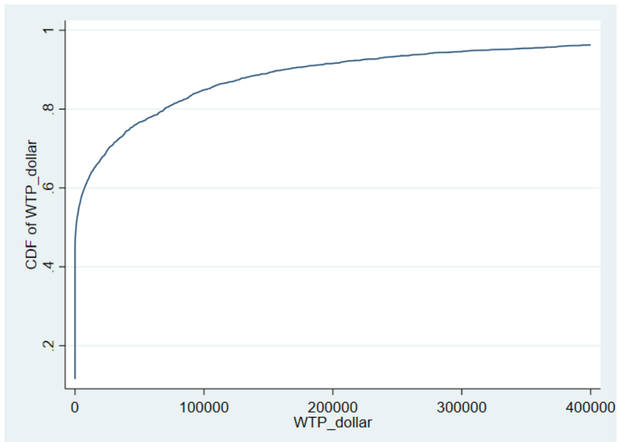
Figure D1 reports the full CDF of ex ante willingness-to-pay discussed in Section 3.5.

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

(a) WTP in a fraction of wealth



(b) WTP in dollars



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

D.2 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 3.5, changes when we remove the heterogeneity in each of the factors in the WTP calculation (equation (3)). This exercise sheds light on the role of each factor in shaping the observed WTP distribution.

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

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

- The marginal value of resources when cognitively declined (assuming the optimal timing of the transfer) compared to that when not cognitively declined ($\bar{V}'(W)/V'(W)$)).[28]

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

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

A. WTP as a fraction of wealth

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

B. WTP in dollars

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

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

The first column shows how the fraction of respondents with a positive WTP changes as we remove the heterogeneity in each variable. This reveals which variables are responsible for generating a zero WTP. The most common reason for a zero WTP is that some people do not worry at all about having the transfer of control at the wrong time conditional on having cognitive decline (i.e., $\hat{x} = 0$). Once we replace this with the sample average of $\hat{x}$, the WTP is zero for less than 20% of the sample.[29] Some have a zero WTP because they

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

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

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

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

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

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