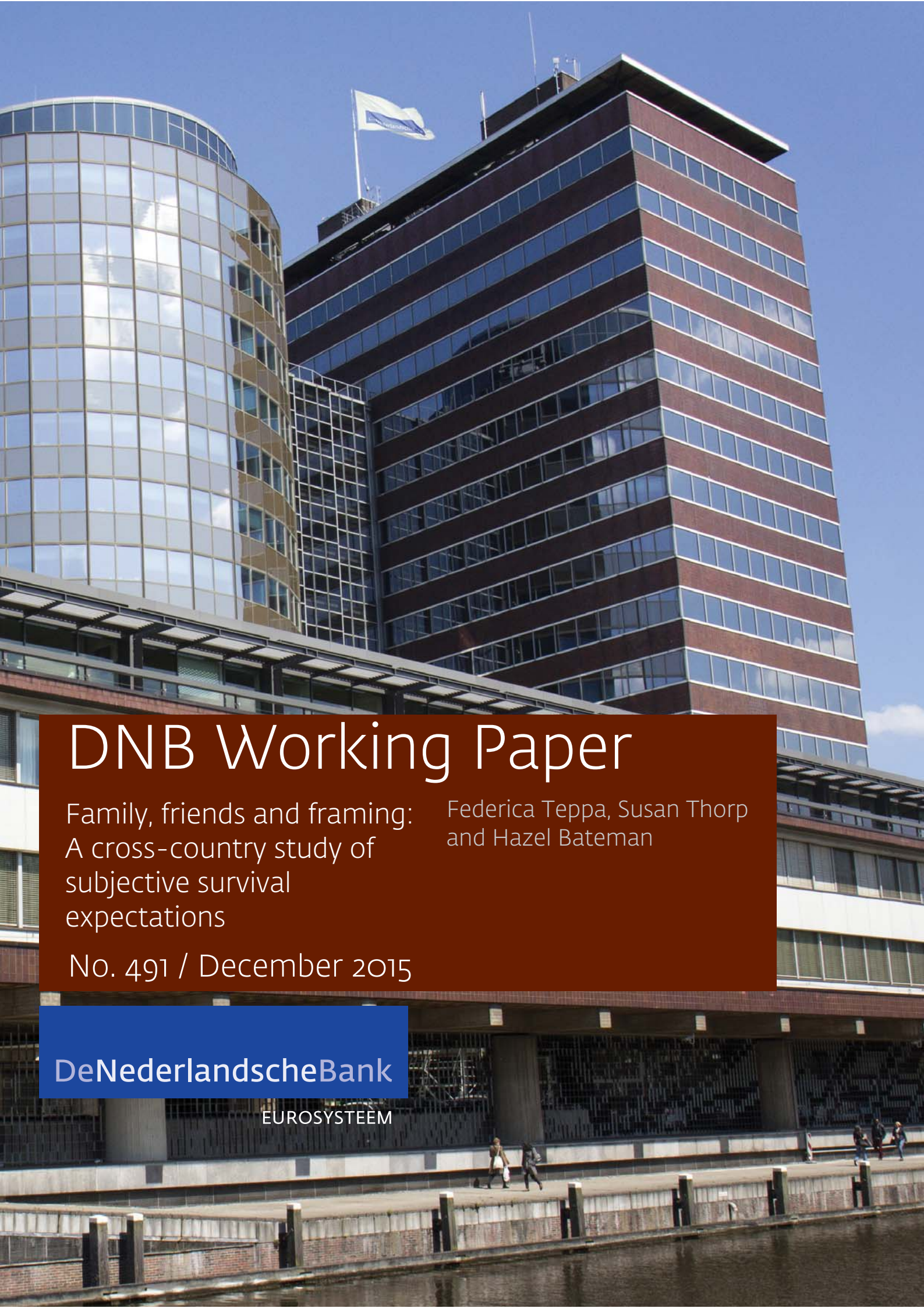

DNB Working Paper

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No. 491 / December 2015

DeNederlandscheBank

EUROSYSTEEM

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* Views expressed are those of the authors and do not necessarily reflect official positions of De Nederlandsche Bank.

Working Paper No. 491

December 2015

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Family, friends and framing: A cross-country study of subjective survival expectations*

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October 2015

Abstract

We implement a two-country online choice experiment on around 2000 respondents per country, first, to investigate the formation of subjective survival expectations; and second, to evaluate the relation between subjective survival expectations and attitudes to pension regulations. Each respondent provided subjective survival probabilities to a range of target ages in either a "live to" or "die by" framing, then subsets of respondents were sorted to conditions where information about current cohort survival, personalized information on same-sex parent or grandparent survival, or both, were provided and the respondent updated their subjective survival expectations. Finally, respondents were asked their views on changes to pension eligibility ages. We find that giving people information about the longevity of peers does not induce them to revise their subjective survival expectations much, and neither does information about the relative longevity of their same-sex parent or grandparent. "Live to" and "die by" framing has a much larger effect on reported subjective expectations than personalized information about cohort or family longevity. However subjective expectations are relevant to explaining opinions on retirement policy and planning. Regulators trying to educate the public about longevity and the consequent need for delayed retirement or pension ages need alternative strategies.

Keywords: Longevity Risk; Framing effect; Survey Data; Hypothetical Choices.
JEL classification: C5, C8, D12, G11.

* We thank CentERdata at Tilburg University for supplying the data of the DNB Household Survey and the staff at the Institute for Choice, University of South Australia, for assistance with the development and implementation of the Australian survey. The paper has benefited from useful comments at the 11th International Longevity Risk and Capital Markets Solutions Conference (Lyon, 7-9 September 2015), at the Netspar Pension Day (Utrecht, 1 October 2015) and at DNB seminars. Bateman and Thorp acknowledge support from Australian Research Council Grant DP1093842. Teppa gratefully acknowledges CEPAR for funding her visit. The views expressed in this paper are those of the authors and do not necessarily reflect those of the institutions they belong to. Any remaining errors are the authors' own responsibility.

1 Introduction

Over the past century, average lifetimes have lengthened dramatically but individuals' forecasts of their own longevity have not kept up. Surveys of subjective survival expectations from a range of developed countries show that people tend to be too pessimistic, underestimating expected lifetimes by around four to five years on average (Wu et al., 2015; Perozek, 2008; Bissonnette et al., 2012). Younger cohorts and women underestimate their chances of a long life more than older cohorts and men (e.g., Hamermesh, 1985; Wenglert and Rosén, 2000; Hurd and McGarry, 2002; Banks et al., 2004; Gan et al., 2005; Elder, 2013; O'Donnell et al., 2008; Teppa and Lafourcade, 2013; Kutlu-Koc and Kalwij, 2013).

Longer lifetimes have "profound economic consequences for individuals as they engage in lifecycle planning, and for economies as the average age of their population rises" (Poterba, 2014, p. 1). A person who underestimates his or her life expectancy is likely to retire too early, save too little, not annuitize enough (Van Solinge and Henkens, 2009; Bucher-Koenen and Kluth, 2013; Bateman et al., 2014; Khan et al., 2014; Teppa and Lafourcade, 2013) and will probably resist increases in pension eligibility ages. Improvements to individual retirement welfare and support for sustainable public policy depend on people holding unbiased estimates of their lifetimes. This raises the question of what can be done to help people improve their forecasts. If all they need is up-to-date information about life expectancy, then a well-timed education program might be enough.

Here we study how people update their subjective survival expectations after receiving objective information about their longevity prospects. We make three contributions to understanding of how survival expectations could be modified. Using new data from surveys of more than 2000 adults in both The Netherlands and Australia, we measure the impact of information about systematic longevity (cohort life expectancies) and of information about idiosyncratic life expectancy (same-sex parent or grandparent's lifetime relative to average) on subjective survival. We also investigate new aspects of framing on expectations, as well as relating individuals' expectations to their attitudes to retirement policy changes and personal savings.

If the systematic or idiosyncratic information we give survey respondents is new to them, we expect them to update their survival expectations consistently with the news. For example, pessimistic survey respondents who receive good news about the longevity of their cohort or family should give more optimistic forecasts at the next round. However, results show that survival expectations overall were very persistent and did not respond to cohort or family survival

information. Many subjects became more pessimistic, others did not revise their expectations significantly and a few revised in the expected direction. Exceptions to pessimistic revisions were more likely to occur among more numerate respondents. Another group of respondents, particularly the older and less numerate people, actually became confused by the new information, answering "don't know" or refusing to answer the subjective survival probability (SSP) tasks after reading about their cohort or ancestor survival. We infer that probabilistic information about longevity might be some help when people have the numeracy to process it, but is otherwise often ineffective or even detrimental. Our results also raise questions about whether there are better ways to explain probabilistic information to unsophisticated decision makers.

Another puzzle in studies of subjective survival expectations is the striking effect of framing. Payne et al. (2013) measure an increase of seven to nine years in the life expectancies survey respondents report when the question is posed as the age people expect to "live-to" rather than as the age they expect to "die-by". Most surveys such as the US Health and Retirement Study (HRS)[1], the Survey of Health, Ageing and Retirement in Europe (SHARE), the US Survey of Consumer Finances (SCF) and the English Longitudinal Study of Ageing (ELSA) elicit survival expectations in a "live-to" frame. We randomly assign respondents to "live to" and "die by" framing in the survey and test the framing effect in two different ways. First, we collect subjective survival probabilities at a range of ages in each frame, confirming that the "live to" treatment group are less pessimistic than the "die by" treatment group and measuring any differences in the effect of the information treatments in each frame. Second, we ask respondents to give a confidence interval around a median lifetime, where the wording associated with the confidence interval and median lifetime is also "live to" or "die by" framed. Australian respondents reported higher median expected lifetimes in the "live to" than in the "die by" frame, as expected. For Dutch respondents, the framing effect virtually disappears for median expected lifetimes where we find no significant differences between frames, but Dutch respondents in the "die by" treatment report a wider confidence interval than respondents in the "live to" treatment. We conclude that, at least for Dutch respondents, the framing effects are connected with second moment estimates.

Retirement policy makers have been responding to increased longevity by adjusting policy settings. In this survey, respondents rated their agreement with statements about three aspects of retirement policy: increasing pension ages with life expectancy; compulsory annu-

[1]Some questions in HRS are now posed in the "die-by" frame, but the predominant framing of the survival expectations questions has been the "live-to" frame.

itization; and personal savings intentions. Because we conduct the survey in The Netherlands and Australia, where retirement savings systems have very wide coverage but very different accumulation and decumulation structures, the connections that we describe between subjective survival expectations and policy settings are more robust and more likely to generalize to other settings. We find that, among respondents in The Netherlands, higher subjective life expectancy is positively related to views that increasing eligibility ages in line with longevity improvement is warranted, but not relevant to explaining views on retirement incomes and does not motivate more savings. In Australia, where annuitization is not automatic and voluntary longevity insurance take up is extremely low, respondents who were more optimistic about their own survival agreed that a longer life meant a need for more savings.

This investigation of how people understand and update survival expectations connects with several strands of literature. First, we add to an expanding body of international data on subjective survival expectations that have been shown to predict actual mortality outcomes in the cross section and to respond to new information about survival prospects (e.g., Smith et al., 2001; Hurd and McGarry, 2002; Hurd, 2009; Rohwedder and Delavande, 2011; Kutlu-Koc and Kalwij, 2013; Post and Hanewald, 2013). Second, studies of financial literacy show that an individual's ability to understand probabilities and risks is related to their economic welfare in areas such as retirement planning, stock market participation and portfolio diversification (e.g., Lusardi and Mitchell, 2011; Lusardi and Mitchell, 2014; Gaudecker and Von, 2014) however programs to improve financial literacy have minimal long term impact on financial behavior when they are not connected with a very immediate financial decision (Fernandes et al., 2014). Our study sheds more light on the relative ineffectiveness of financial information interventions that are not related to an immediate decision. Third, our study builds on evidence that the effective communication of risk information is very challenging and sensitive to the formulation used (see, for example, Spiegelhalter et al., 2011; Payne et al., 2013; Bateman et al., 2015) but also constrained by low statistical literacy in the general population (Galesic and Garcia-Retamero, 2010; Cokely et al., 2012).

In section 2 below we outline the setting for the study, describing and comparing the demographics, financial literacy and retirement savings systems of The Netherlands and Australia. The next section describes the survey and experimental design along with the specific questions we address. Section 4 presents the effect of different frames on reported subjective survival probabilities. Section 5 explores how people revise their reported survival prospects after re-

ceiving additional information. Section 6 reviews the impact of subjective survival expectations on retirement policy and personal saving intentions and Section 7 concludes.

2 Context

The Netherlands and Australia are countries with many similarities but important differences in pension system design. The Netherlands population is around 17 million, compared with around 23 million in Australia. GDP per capita in USD was close to $52K in 2014 in The Netherlands, compared with $62K for Australia (World Bank 2015), and average life expectancy at birth in 2013 was 81 years in The Netherlands and 83 years in Australia (World Health Organisation 2015). Educationally, both countries ranked in the top 20 for mathematics, reading and science in the OECD Programme for International Student Assessment (PISA) scores in 2012, though The Netherlands does better in mathematics. Dutch adults also do better than Australians on standard tests of financial literacy and numeracy, although the differences are not large. Over 46% of Dutch adults aged 25-65 could give correct answers to three questions on interest rates, inflation and diversification (Alessie et al., 2011), compared with 43% of Australian adults of the same age (Agnew et al., 2013). By comparing survey outcomes from The Netherlands and Australia, we can show whether the results are likely to generalise to other developed economy settings.

Our comparison is more interesting when we take account of the retirement savings systems in The Netherlands and Australia. The Melbourne Mercer Global Pensions Index, an annual comparative evaluation of pension systems around the world, consistently ranks Australia and The Netherlands in the top three pension systems from among 25 countries, with Denmark (MMGPI, 2014). Although both systems are closely ranked on this measure, they have important differences. For the first pillar, The Netherlands has a flat rate universal public pension that can now be drawn from age 65. The eligibility age for this first pillar payment is being raised to 67 by 2023 and will rise with life expectancy thereafter. Australia has a means-tested (rather than universal) first pillar public pension, but almost 75% of age-eligible retirees receive a full or part pension. The Australian public pension can also be drawn from age 65. Like The Netherlands, Australia is increasing the age pension eligibility age to 67 by 2023 and although not legislated, policy makers have discussed further increasing the age to 70. The Netherlands pension payment is around 30% of average earnings, uprated with minimum wages and Australia's is around 28% of average earnings indexed to the greater of 25% of male average weekly

earnings, the consumer price index and the pensioner cost of living index. Both countries anticipate fiscal pressure from increasing transfers to the elderly, so there is debate about sustainable eligibility ages. We propose that if voters underestimate their survival prospects, they are also likely to resist increases in pension ages.

Subjective longevity expectations are also important to private pension provision and retirement saving. Both countries operate second pillars that have broad coverage: The Netherlands has around 90% of workers covered by quasi-mandatory occupational pension plans with (defined) benefits calculated on the basis of lifetime average earnings. The access age is 65 rising to 67. While Australia also has over 90% coverage in the mandatory second pillar (called the "Superannuation Guarantee"), most workers hold accounts in defined contribution plans and access is much earlier than in The Netherlands: the access age is 55 years, rising to 60 for those born from July 1964. Australian regulators are discussing further increases to contribution rates (currently 9.5% of earnings and expected to increase to 12%) and the access age.

Decumulation policies in the two countries are dramatically different and lively debate is underway about the best way to support retirement incomes. In The Netherlands, annuitization is compulsory at replacement rates around 70%, with more flexibility in decumulation under consideration. Australia has no compulsory decumulation structure and replacement varies, particularly since the mandatory retirement saving system was only introduced in 1992 and is not yet fully mature. Many current participants have not contributed over their full working life and retire with only modest accumulations. Annuitization rates in Australia are very low: currently 50% of assets are cashed out as lump sums while most of the remainder is withdrawn through tax-preferred phased withdrawal accounts with only a few thousand annuities sold annually (Iskhakov et al., 2015).

We are interested to see whether the differences in retirement incomes systems in two quite similar developed countries result in different attitudes to policy reform related to rising longevity. We are also interested in whether subjective survival expectations influence opinions about policy in similar or different ways in these settings.

3 Survey and experimental design

In order to investigate subjective survival expectations we design and implement an experimental survey in The Netherlands and Australia. The survey had three main parts. The first part asked respondents about the survival experience and causes of death of their same-sex parent

and/or grandparent; allocated respondents to the "live to" or "die by" framing, and then to either a control group or one of three conditions; and then elicited subjective survival probabilities and confidence intervals in one to four rounds.[2] The next section measured agreement with three statements about retirement savings policy and behavior and asked respondents to rank the importance of retirement savings policy among a list of other government policies of that were likely to vary in their importance both within and between respondents. Subjects then completed questions measuring numeracy using the (Lipkus et al., 2001) inventory of three questions on proportions, percentages and probabilities. At this point, Australian respondents answered more demographic and health questions that were not presented to the Dutch panel since they were collected at other regular phases of the De Nederlandsche Bank (DNB) Household survey and so were already available to the researchers.

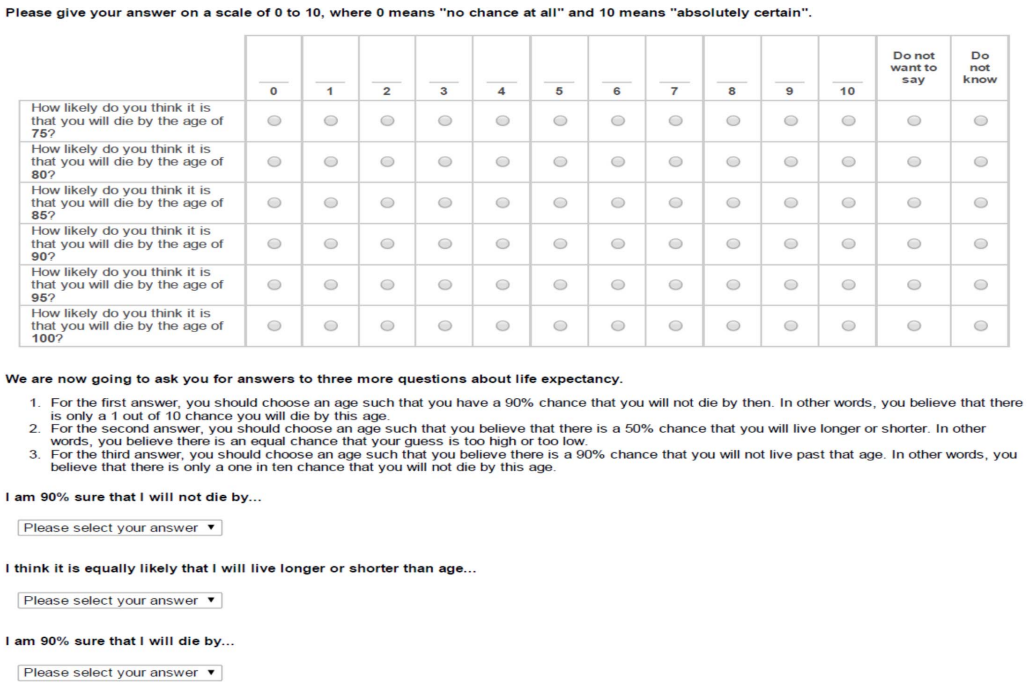
The survey was first written in English, and then translated to Dutch and reviewed before being fielded to the CentERdata panel in The Netherlands in October 2014. It was then re-translated back to English by a native Dutch speaker and checked again before being fielded in Australia in May 2015, to ensure consistent meanings in the two samples. We used cohort and ancestor survival information from the life tables in each country.[3] We changed the wording of the policy questions to match the differences between the Australian and Dutch settings, but held the topics constant.

3.1 Subjective survival probability task

Subjects entered responses for ages from 75 to 100 in five year steps, assigning values on a scale from zero ("no chance at all") to 10 ("absolutely certain") to prospects of survival at each target age. The wording of the question at each target age was set to either a "live to" or "die by" frame with half of the sample randomly assigned to each. We thus measured framing effects between respondents. Figure 1 shows a screenshot of the table that respondents used to rate survival prospects in the "die by" frame. Subjects then gave a confidence interval around median life expectancy by answering the following questions: "I am 90% sure that I will *not die by (live to)...* with age selected from a drop down list; "I think it is equally likely I will live longer or shorter than"; and "I am 90% sure I will *die by (not live to)...* with age selected from a drop down list. Figure 1 shows the complete explanation and wording of the confidence

[2] In the Australian survey, where an internet panel provided the sample, respondents were invited by email to take the survey then filtered to match population age and gender proportions before undertaking the task.

[3] We used the 2012 life tables from Centraal Bureau voor de Statistiek (CBS) for The Netherlands, and the 2013 Life Tables from the Australian Bureau of Statistics for Australia.



Please give your answer on a scale of 0 to 10, where 0 means "no chance at all" and 10 means "absolutely certain".

	0	1	2	3	4	5	6	7	8	9	10	Do not want to say	Do not know
How likely do you think it is that you will die by the age of 75?	○	○	○	○	○	○	○	○	○	○	○	○	○
How likely do you think it is that you will die by the age of 80?	○	○	○	○	○	○	○	○	○	○	○	○	○
How likely do you think it is that you will die by the age of 85?	○	○	○	○	○	○	○	○	○	○	○	○	○
How likely do you think it is that you will die by the age of 90?	○	○	○	○	○	○	○	○	○	○	○	○	○
How likely do you think it is that you will die by the age of 95?	○	○	○	○	○	○	○	○	○	○	○	○	○
How likely do you think it is that you will die by the age of 100?	○	○	○	○	○	○	○	○	○	○	○	○	○

We are now going to ask you for answers to three more questions about life expectancy.

1. For the first answer, you should choose an age such that you have a 90% chance that you will not die by then. In other words, you believe that there is only a 1 out of 10 chance you will die by this age.
2. For the second answer, you should choose an age such that you believe that there is a 50% chance that you will live longer or shorter. In other words, you believe there is an equal chance that your guess is too high or too low.
3. For the third answer, you should choose an age such that you believe there is a 90% chance that you will not live past that age. In other words, you believe that there is only a one in ten chance that you will not die by this age.

I am 90% sure that I will not die by...

Please select your answer ▾

I think it is equally likely that I will live longer or shorter than age...

Please select your answer ▾

I am 90% sure that I will die by...

Please select your answer ▾

Figure 1: Screenshot of task

interval. In each case, we explained the percentage probability as a frequency in 10, to make it easier to understand the probabilities (Spiegelhalter et al., 2011).

All respondents completed the tasks shown in Figure 1 once before we gave them any new information. We then assigned them to one of three information conditions or to the control group. The control group did not repeat the SSP tasks. The group assigned to the first condition read information about their same-sex cohort survival prospects and repeated the SSP tasks. We could only assign respondents to the second or third conditions who had told us earlier about the death of a same-sex parent or grandparent - that is, people whose same sex parent and grandparent were both alive, who answered “don’t know” or refused these questions could not be assigned to these treatments. This conditional assignment is consistent with the intention of the study, since people who don’t know the survival of their family will not be basing their subjective survival expectations on family history. The second group read information about the survival of their parent or grandparent relative to that ancestor’s birth cohort then repeated the SSP tasks. The third group read information about their own cohort and their ancestor’s survival and did the SSP tasks after each. Table 1 summarises the experiment structure and

reports the number of people who completed each condition in each country.

Table 1: Information treatments and sample sizes

	NL	AUS		NL	AUS
No treatment	2,095	2,178	Cohort survival	727	545
Ancestor survival	725	544	Cohort and ancestor survival	671	544
Total	2,095	2,178			

Notes: Cohort survival information: "On average, women (men) born the same year as you have an x in 10 chance of living to age 75; a y in 10 chance of living to age 85 and a z in 10 chance of living to age 95." Same sex parent/grandparent (ancestor)survival information: "Compared with other women (men) born at the same time, your mother (father, grandmother, grandfather) lived x years longer (shorter) than average."

Policy and numeracy questions followed the SSP tasks. Each subject in the DNB Household survey panel read a statement about government policy: *The age at which people are eligible for their pension in The Netherlands is increasing from 65 to 67. The increases have started in 2013 and will take until 2023. After 2023 the pension eligibility age will be tied to general life expectancy. This means that if people on average live longer, the pension eligible age will also increase.* They then stated their agreement (1="agree", 2="neither agree nor disagree"; 3="disagree"; do not know, do not want to say) with these propositions:

- The pension-eligible age for additional pension should increase with the average life expectancy
- The government should allow people to be paid out of their saved pension in whatever way they want; a limited number of years at an annual amount, a pension during the remainder of their life, or as a one-off payment.
- If I knew I would live for 10 more years than I expect to now, I would put more money aside than I currently do.

Australian respondents read a similar statement about pension changes: *In Australia the age when people can start receiving the age pension is gradually increasing from 65 to 67, starting in 2017 and ending in 2023. The government is also considering increasing the age when people can start receiving the Age Pension to 70 by 2035.* They then stated their agreement with these propositions:

- The age when people can start receiving the Age Pension should increase with average life expectancy.

- The government should give people the choice to take their retirement savings any way they like, as an annuity, pension, or lump sum.
- If I knew that I was going to live 10 years longer than I expect to now, I would save more than I do now.

3.2 Sample

In The Netherlands, the survey was fielded during October 2014, using the CentERpanel. Of the 2620 panel members over the age of 16 who were sent the survey 2095 respondents completed, resulting in a response rate of 75.3%. In Australia, the survey was fielded in May 2015 using Australian members of the GMI Lightspeed (`http://www.gmi-mr.com/`) online panel. Australian respondents were over the age of 18, and 2178 completed the survey. They were paid around $4AUD for completing the survey.

Table 2: Summary statistics

Variable	**Mean**	**Std.Dev.**	**Min.**	**Max.**	**Mean**	**Std.Dev.**	**Min.**	**Max.**
	Netherlands N=2,095				Australia N=2,178			
Female	0.477	0.499	0	1	0.503	0.500	0	1
Age (in years)	53.576	16.476	16	92	46.066	17.296	18	95
Year of birth	1960	16.452	1922	1998	1968	17.296	1920	1997
With a partner	0.765	0.423	0	1	0.612	0.487	0	1
With children	0.355	0.478	0	1	0.382	0.486	0	1
Employed	0.462	0.498	0	1	0.541	0.498	0	1
Retired	0.264	0.441	0	1	0.199	0.399	0	1
Gross hh annual income - q1	30,000 €	0			18,000 €	0		
Gross hh annual income - q2	44,000 €	0			40,950 €	0		
Gross hh annual income - q3	61,800 €	0			63,700 €	0		
Gross hh annual income - q4	166,800 €	0			163,800 €	0		

Notes: For Australia, two observations are deleted corresponding to reported age equal to 113 years. For gross household income, in The Netherlands this variable is collected on a monthly basis. To make it comparable with Australia, we transformed gross monthly income into gross annual income by multiplying by 12. We then computed quartiles for both countries in Euros at the exchange rate prevailing at the time the Australian survey was collected.

Most respondents gave answers to the survey questions that are consistent with increasing mortality at older ages. In the Dutch sample, 36 respondents reported non-monotonic SSPs and 66 gave invalid confidence intervals, representing 4.8% of the total sample. For Australia, the rate of invalid responses was much higher, with 131 non-monotonic responses to SSPs but 273 invalid responses to the confidence interval questions or 18.5% of the total sample. Dutch respondents have had more practice in answering probabilistic questions than the Australian respondents, because of their regular participation in the DNB panel, which could explain the

lower rate of invalid answers.

In the next section we discuss the effects of framing across all information conditions, then we describe the effects of new survival information and explore any important interactions between the framing and information conditions. After that we look into the relationship between SSPs, conditions and attitudes to retirement savings policy.

4 Framing effects on subjective survival probabilities

When US survey respondents reported subjective survival probabilities in response to a "live to" frame they showed significantly more optimism than respondents who answered questions in a "die by" frame (Payne et al., 2013): there was a 10 year difference between life expectancies. Payne et al. found that the respondents shown the "live to" frame were more likely to report thinking about living at the time they answered the survey than respondents in the "die by" frame. The authors argued that this could partly explain their longer estimated lifetimes.

If framing is always so influential, the way that life expectancy is described could have large, unintended effects on households' planning and attitudes to policy. Framing that elicits more optimistic expectations is likely to support peoples' plans to work longer, insure against longevity and decumulate more slowly. Here we test the external validity of earlier US studies of framing by measuring the effects of "live to" versus "die by" framing among Dutch and Australian respondents. We randomly assigned respondents to either the "live to" or "die by" setting for all information conditions in the survey. Respondents in both frames report SSPs and confidence intervals.

Table 3 reports the differences between SSPs that were collected from all respondents before we provided any additional cohort or ancestor survival information, and where respondents give a valid answer. (We exclude responses where respondents have chosen "do not know" or "do not want to say" or where they have assigned a higher probability to being alive at an older age than at a younger age, i.e., gave non-monotonic answers. More invalid answers were given in the "die by" frame.) These results highlight the effect of live to/die by framing on subjective survival probabilities. Respondents from both The Netherlands and Australia are significantly less pessimistic in the "live to" than in the " die by" framing, consistent with results from Payne et al. (2013). Differences in reported subjective survival are significant at the 1% level for all target ages and for both countries' surveys. Although not obvious in the table, where gender and age are aggregated, framing affected both males and females about equally but the effects

were significantly stronger for younger than older respondents of both nationalities.

Before respondents reported their SSPs in our surveys, we asked them about the survival and causes of death of their same-sex parent or grandparent so that we could use the information in later treatments. By bringing the mortality of their family members to mind, respondents might have been primed to have more thoughts of death and consequently more pessimism than if we asked for SSPs without reminding people about their ancestor's passing.

Table 3: Summary Statistics: Subjective Survival Probabilities

	Mean and (Std. Dev.)					
	NL			AUS		
Variables	Full Sample	Males	Females	Full Sample	Males	Female
"live to" condition						
SSP to Age 75	7.55	7.45	7.67	7.49	7.64	7.37
	(1.95)	(1.90)	(2.00)	(2.36)	(2.44)	(2.29)
SSP to Age 80	6.41	6.35	6.47	6.85	6.97	6.75
	(2.29)	(2.21)	(2.36)	(2.66)	(2.73)	(2.60)
SSP to Age 85	5.18	5.13	5.23	5.99	6.09	5.90
	(2.46)	(2.44)	(2.48)	(2.89)	(2.89)	(2.88)
SSP to Age 90	3.62	3.60	3.64	4.88	5.02	4.76
	(2.42)	(2.37)	(2.47)	(3.12)	(3.18)	(3.06)
SSP to Age 95	2.27	2.31	2.22	3.78	3.97	3.63
	(2.18)	(2.13)	(2.24)	(3.09)	(3.19)	(2.99)
SSP to Age 100	1.28	1.31	1.24	2.61	2.72	2.51
	(1.87)	(1.88)	(1.85)	(2.89)	(3.01)	(2.78)
Median lifetime (SML)	78.25	78.73	77.68	74.08	72.22	75.97
	(9.40)	(8.98)	(9.87)	(16.58)	(18.69)	(13.90)
N.Obs.	684	375	309	928	467	461
"die by" condition						
SSP to Age 75	6.29	6.32	6.26	5.28	5.12	5.44
	(2.29)	(2.29)	(2.30)	(2.93)	(3.18)	(2.65)
SSP to Age 80	5.01	5.07	4.94	4.38	4.22	4.54
	(2.43)	(2.50)	(2.36)	(2.85)	(3.03)	(2.65)
SSP to Age 85	3.75	3.90	3.59	3.46	3.45	3.47
	(2.41)	(2.49)	(2.32)	(2.67)	(2.80)	(2.53)
SSP to Age 90	2.41	2.62	2.18	2.53	2.53	2.53
	(2.19)	(2.36)	(1.95)	(2.55)	(2.65)	(2.44)
SSP to Age 95	1.50	1.72	1.24	1.88	1.93	1.84
	(2.06)	(2.32)	(1.69)	(2.55)	(2.70)	(2.39)
SSP to Age 100	0.93	1.15	0.67	1.33	1.35	1.31
	(2.11)	(2.41)	(1.66)	(2.55)	(2.67)	(2.43)
Median lifetime (SML)	78.07	78.98	77.01	72.17	70.97	73.45
	(8.92)	(8.96)	(8.78)	(16.65)	(17.86)	(15.17)
N.Obs.	612	328	284	923	478	445

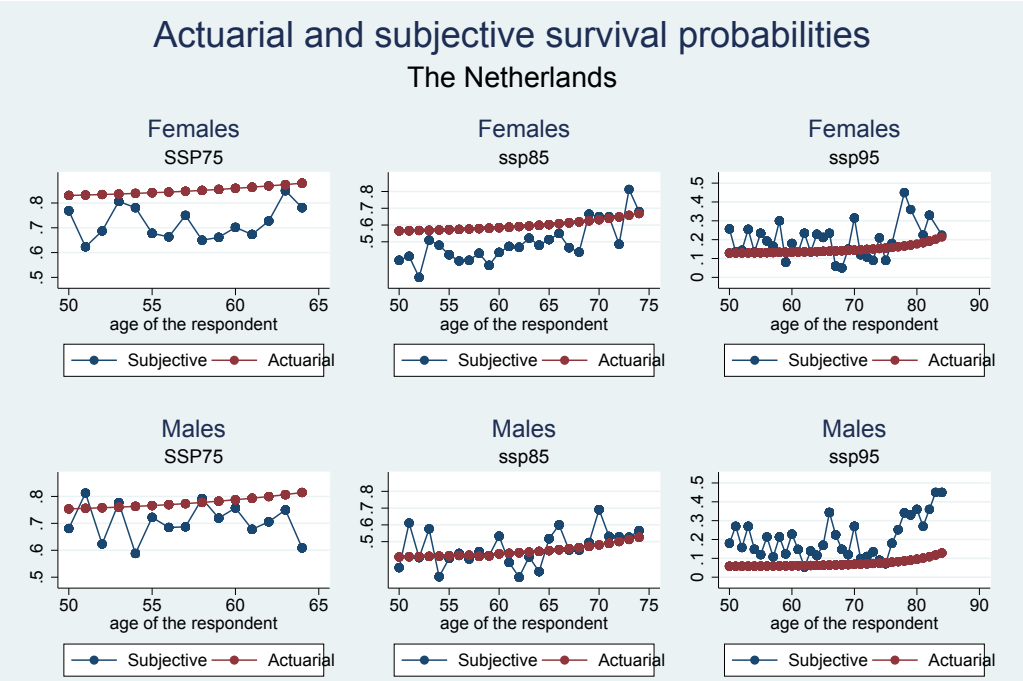
Table reports summary statistics of subjective survival probabilities (SSP), inferred expected lifetimes and subjective median lifetimes (SML). Median lifetimes are computed as the average over subjective medians from confidence interval questions.

Table 3 shows some marked differences in SSPs by nationality, gender and frame. Overall, Australian respondents are more sensitive to framing than Dutch respondents: the difference between the average SSPs in the "live to" and "die by" frame is generally larger for Australia than The Netherlands. (This difference could be related to the younger average age of the Australian respondents since framing effects are larger among younger respondents.) Australians are more optimistic about surviving to older ages than Dutch respondents, especially in the "live to" frame, and more pessimistic about near age survival in the "die by" frame. Males from both countries are more optimistic than females about survival at very old ages, contrary to objective average mortality patterns, and Australian women are consistently more pessimistic than Australian men in the "live to" frame, again contrary to objective survival patterns. Our finding of older age optimism and younger age pessimism, and more pessimism among women than men, is consistent with other studies of subjective survival expectations (e.g., Wu et al., 2015; Kutlu-Koc and Kalwij, 2013).

The differences between subjective survival expectations and actuarial survival prospects are highlighted in the Figure 2. There is a clear pattern of pessimism about survival to younger ages, and optimism (at least for males) about survival to older ages when compared with the actuarial data from the current life tables. Furthermore the actuarial data shown here assume that a person now aged 30, for example, will experience the same mortality prospects at age 75 as people currently aged 74. Thus the comparison in these figures minimizes the underlying pessimism of subjective survival expectations, since the actuarial lines do not include improvements to mortality that individuals are likely to experience over their future years. People who underestimate their chances of surviving to relatively young ages, such as 75, are likely to save too little in the years approaching retirement, while overestimating the chances of living to old ages such as 95 or 100 can lead to overly cautious decumulation (Wu et al., 2015). If additional information about cohort or ancestor survival can correct these biases, people are likely to manage their wealth more efficiently over the life cycle.

4.1 Framing effects on confidence interval estimations

Results in Table 3 demonstrate that framing affects means and standard deviations of reported subjective survival probabilities, but also that these statistics differ by country. Standard deviations of SSPs are lower lower for the Dutch in the "live to" than "die by" frame, SSPs are also lower among Dutch than Australian respondents. By contrast, for Australian respondents,



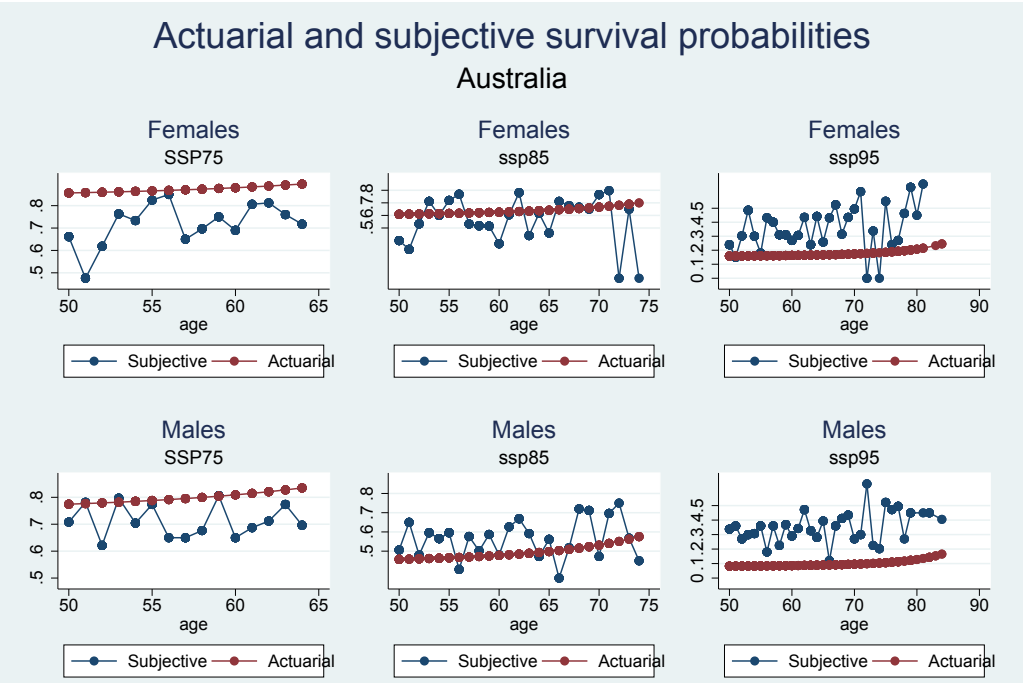


Figure 2: Subjective and Actuarial Survival

standard deviations of SSPs are lower in the "die by" than the "live to" frame. Differences by country also show up in confidence interval estimates, but in unexpected ways. These differences are illustrated in Table 4 and we discuss them below.

The confidence interval question in the survey asked respondents to be explicit about the median ("I think it is equally likely that I will live longer or shorter than...") and the tails ("I am 90% sure that I will not die by (will die by) (*live to, not live to*) of their subjective survival distribution. We find here that framing effects on the confidence interval are not the same as on the SSPs. Unlike the SSPs where the responses to the "live to" framing were significantly more optimistic than the "die by" frame, median ages at death for Dutch respondents are not significantly different between frames. However, for Australian respondents, median ages in the "die by" frame are significantly lower than in the "live to" frame, consistent with the direction of the effect found by Payne et al. (2013). These results suggest that the "live to" v. "die by" framing effect depends partly on the probability task that respondents are given. However it is also worth noting that for both frames and both countries, average subjective median lifetimes are still too low when compared with the actual median lifetimes being experienced by the adult populations of each country. In other words, asking for a median lifetime does not correct bias.

Confidence intervals elicited in the "die by" frame are significantly wider than intervals elicited in the "live to" frame for Dutch respondents. Lower bounds are lower (70 c.f. 72 years) and upper bounds are higher (91 c.f. 90 years) than in the "live to" frame, suggesting no particular skew to the framing effect on confidence intervals. In other words, the "die by frame" is related to more uncertainty about living longer. By comparison, there are no significant differences between the sizes of confidence intervals reported by Australian respondents in the two frames.

Table 4: Median ages and confidence intervals - treatment and framing effects

NL	**No info**	**Cohort**	**Ancestor**	**Cohort & ancestor**
		Median ages		
Live to	78.25	78.50	79.39	80.42
Die by	78.07	78.86	79.14	79.45
Combined	78.17	78.66	79.27	79.95
Difference	0.18	-0.36	0.25	0.96
p-value	0.357	0.276	0.356	0.176
N.Obs.	1,296	822	637	221
		Confidence intervals		
Live to	17.89	17.49	16.87	16.25
Die by	21.79	20.53	19.88	17.45
Combined	19.72	18.88	18.31	16.84
Difference	-3.90	-3.04	-3.01	-1.20
p-value	0.000	0.000	0.001	0.155
N.Obs.	1,294	826	634	222
AUS	**No info**	**Cohort**	**Ancestor**	**Cohort & ancestor**
		Median ages		
Live to	74.08	76.81	80.25	79.87
Die by	72.17	73.62	75.56	75.90
Combined	73.13	75.23	77.94	77.88
Difference	1.91	3.18	4.69	3.97
p-value	0.007	0.000	0.000	0.000
N.Obs.	1,851	1,409	467	464
		Confidence intervals		
Live to	19.08	18.85	17.22	17.34
Die by	18.11	16.98	16.67	17.04
Combined	18.56	17.90	16.94	17.19
Difference	0.97	1.87	0.56	0.29
p-value	0.196	0.012	0.331	0.411
N.Obs.	1,985	1,416	469	466

4.2 Individual consistency between confidence intervals and SSPs

Before we move on to consider the effects of information conditions on survival expectations, we evaluate the consistency of SSPs with confidence interval estimations. On average, respondents' confidence intervals and SSP responses are consistent with each other in the "live to" frame. We test for consistency by comparing the average SSP at each target age of respondents who report a lower bound to their survival confidence interval above that target age with the average SSP of respondents who report a lower bound below that target age, expecting that the average SSP for the former will be higher than the latter. For example, on average, respondents who say they are 90% sure they will live to age 80 or higher should choose higher probabilities of

living to age 80 than respondents who say they are 90% sure they will live only to age 79 or less. Using the same approach, we check for consistency between SSPs and the upper bounds of respondents' confidence intervals by testing to see if average SSPs at each target age of the group of respondents who say they are 90% sure that will *not* live to that target age are lower than the group who choose a higher upper bound. We exclude invalid SSP responses.

Dutch respondents who set their lower bound at 75 or older also report SSPs at age 75 that are 19.8% higher than respondents who set their lower bound below age 75. Similarly, respondents who set their lower bound at 85 or older report SSPs at age 85 that are 35.8% higher than the respondents who are 90% sure of living to a younger age. The pattern of more optimistic subjective expectations of survival for the group with a lower bound above the target age holds across all target ages and is significant at the 1% level in a test of differences in means. We find the same consistency at the upper bound of confidence intervals too. Dutch respondents who say they are 90% sure they will not live to age 75 or less also have an average SSP to age 75 that is 14.9% lower than the respondents who say they will not live to an older age, and those who report an upper bound at age 80 or less also discount their survival to age 80 by 41% more than respondents who a higher upper bound. Differences are negative and significant at all target ages. Australian respondents in the "live to" frame were similarly consistent in reporting confidence interval boundaries and SSPs.

Dutch respondents in the "die by" frame followed largely the same pattern with one noticeable difference. When giving their confidence interval lower bound ("I am 90% sure I will not die by age...") the group of respondents choosing a bound equal to or higher than age 75 reported an average SSP at age 75 that was 13.5% *lower* than the group of respondents who choose a lower bound at a younger age. At older target ages, the difference in average SSP was positive, as expected and as we found for the "live to" frame. Australian respondents in the "die by" frame were more consistent at lower target ages than the Dutch, but we could find no clear pattern of consistency or inconsistency at older target ages.

On this test, SSP and confidence interval elicitation of survival prospects are largely consistent, which is one sign that respondents understand the survey questions and have similar ideas of survival in mind when they answer different questions. However, asking about survival probability to a series of target ages seems more susceptible to framing than asking about a median lifetime. For Dutch respondents at least, the "die by" frame is also associated with wider confidence intervals, suggesting that negative framing is related to more uncertainty about

longevity.

5 Effect of cohort and ancestor information on subjective survival probabilities

Can giving people information about their cohort or ancestor survival reduce any biases in their subjective survival expectations? Does the extent to which people update using new information depend on how numerate they are? If giving accurate general information helps people to update their expectations, then we could eventually see improvements in retirement planning for very small effort. In this section we report the results of combining actuarial information about their cohort and family's survival with respondents' own information, to help them update their subjective survival expectations.

5.1 Reports of same-sex ancestor mortality

Before we could implement information conditions, we asked respondents about their family survival experience. We found that the main features of respondents' reports of parent and grandparent survival fit population patterns reasonably well. In The Netherlands and Australia, respondents reported significantly more surviving mothers than fathers, and higher ages at death for female than male ancestors, consistent with the longer average lives of women. Cancer was reported as the most common cause of death for parents in both countries (around 25%), with heart disease as the second most common cause (around 15%). This ranking and prevalence is broadly consistent with observed causes of death in the populations, if deaths from different types of cancers are grouped together. Grandparents' deaths were also often attributed to cancer or heart disease, as well as Dementia, Alzheimer's or Parkinson's disease. However a large proportion of respondents (around 22% in The Netherlands and around 15% in Australia) reported that they did not know their grandparent's cause of death.

Familial risk of disease is likely to be important to many respondents' assessments of their own longevity prospects, especially those who remembered the causes of the death of their same-sex ancestors. Answering these preliminary questions is likely to have brought familial survival patterns to the minds of respondents as they answered the rest of the survey. We also gave them specific information about the relative longevity of their same-sex parent or grandparent in two of the conditions discussed below.

5.2 Cohort, ancestor and cohort plus ancestor information conditions

The top panel of graphs shown in Figure 2 highlight biases in survival expectations among the Dutch respondents. The overall pessimism about survival of Dutch females is most evident at target ages below 85 and for younger respondents. Dutch males are also pessimistic for younger target ages on average, but more optimistic in their expectations of living to older ages. We expect that giving respondents information about the true survival prospects of their birth cohort should cause the to update towards unbiased probabilities.

In fact, Dutch respondents do revise, but not in the direction we would predict, as shown in Table 5. In the "live to" frame, after new survival information, respondents in the conditions revised their SSPs downwards, expressing even more pessimism. Table 5 reports combined data, but we found that for males, the pessimistic revisions were always statistically significant. Females also made downwards revisions, though the size was not always statisticallly significant. The average size of all the changes were quite small, at less than 1 (or 10%) on average. A similar pattern emerged for the "die by" frame, where respondents revised their SSPs downwards for target ages above 85 after being given information, but their changes were not significantly different from the control.

Table 5: Revisions to SSPs under information conditions, Dutch respondents

	SSP75	**SSP80**	**SSP85**	**SSP90**	**SSP95**	**SSP100**
			Live to frame			
None (control)	7.48	6.31	5.05	3.52	2.21	1.24
Cohort only	7.27	6.03	4.78	3.17	1.93	1.01
Difference from control	0.21	0.28	0.27	0.34	0.28	0.23
p-value	0.001	0.000	0.000	0.000	0.000	0.000
N.Obs.	370	429	460	475	487	490
None (control)	7.58	6.54	5.22	3.63	2.24	1.20
Ancestor only	7.42	6.31	5.00	3.42	2.04	1.00
Difference from control	0.16	0.23	0.22	0.21	0.20	0.20
p-value	0.012	0.001	0.001	0.002	0.000	0.000
N.Obs.	253	310	336	347	357	359
None (control)	7.65	6.66	5.21	3.48	2.08	1.10
Cohort and ancestor	7.36	6.36	4.93	3.14	1.84	0.88
Difference from control	0.29	0.30	0.28	0.34	0.24	0.22
p-value	0.042	0.004	0.019	0.002	0.008	0.001
N.Obs.	82	107	116	122	125	124
			Die by frame			
None (control)	3.64	5.05	6.29	7.76	8.73	9.40
Cohort information	3.70	5.14	6.31	7.69	8.65	9.33
Difference	-0.06	-0.09	-0.02	0.07	0.08	0.07
p-value	0.257	0.145	0.441	0.161	0.085	0.060
N.Obs.	250	289	333	362	383	393
None (control)	3.69	4.88	6.20	7.67	8.84	9.44
Ancestor only	3.74	4.85	6.18	7.67	8.70	9.44
Difference from control	-0.05	0.03	0.02	0.00	0.14	0.00
p-value	0.287	0.342	0.392	0.500	0.018	0.477
N.Obs.	199	243	282	301	318	328
None (control)	3.51	5.07	6.23	7.74	8.90	9.47
Cohort and ancestor	3.65	4.85	6.20	7.55	8.68	9.41
Difference from control	-0.16	0.22	0.03	0.19	0.22	0.06
p-value	0.243	0.116	0.424	0.138	0.054	0.291
N.Obs.	55	71	91	102	109	112

Table 6 shows the reactions of Australian respondents to information about cohort and ancestor longevity. In the "live to" frame, Australian male respondents followed the pattern of pessimistic revisions we observed for Dutch males, although most changes were not statistically significant. Australian women, by contrast, revised their expectations to target age 75 significantly upwards, and their expectations to target age 90 significantly downwards, although the magnitude of changes on average was small. The changes made by Australian women for these two age targets are in the expected direction given the biases we observe for the control responses in Figure 2. For the "die by" frame, most significant responses to new information

are again pessimistic, with the exception of more optimism at very old ages for the cohort plus ancestor information condition.

Table 6: Revisions to SSPs under information conditions, Australian respondents

	SSP75	**SSP80**	**SSP85**	**SSP90**	**SSP95**	**SSP100**
			Live to frame			
None (control)	7.63	7.05	6.08	4.96	3.79	2.71
Cohort only	7.81	7.03	6.12	4.83	3.77	2.69
Difference with control	-0.18	0.02	-0.04	0.13	0.02	0.02
p-value	0.001	0.387	0.302	0.069	0.382	0.377
N.Obs.	249	264	275	289	284	283
None (control)	7.33	6.60	5.65	4.49	3.35	2.12
Ancestor only	7.33	6.55	5.65	4.36	3.29	2.15
Difference with control	0.00	0.05	0.00	0.13	0.06	-0.03
p-value	0.478	0.200	0.462	0.044	0.186	0.293
N.Obs.	252	283	294	309	313	310
None (control)	7.67	7.06	6.11	4.96	3.75	2.53
Cohort and ancestor	7.99	7.05	6.07	4.70	3.65	2.56
Difference with control	-0.32	0.01	0.04	0.26	0.10	-0.03
p-value	0.002	0.435	0.321	0.005	0.139	0.342
N.Obs.	170	190	196	204	202	201
			Die by frame			
None (control)	4.68	5.54	6.64	7.66	8.32	8.93
Cohort only	4.77	5.83	6.86	7.72	8.41	8.95
Difference with control	-0.09	-0.29	-0.22	-0.06	-0.09	-0.02
p-value	0.247	0.004	0.023	0.223	0.087	0.400
N.Obs.	164	181	194	209	215	216
None (control)	4.77	5.75	6.52	7.77	8.50	9.16
Ancestor information	4.90	5.92	6.77	7.84	8.59	9.20
Difference	-0.13	-0.17	-0.25	-0.07	-0.09	-0.04
p-value	0.117	0.040	0.003	0.153	0.115	0.252
N.Obs.	162	182	201	212	219	220
None (control)	4.92	5.73	6.67	7.91	8.54	9.02
Cohort and ancestor	5.07	6.10	6.86	7.33	7.60	7.81
Difference with control	-0.15	-0.37	-0.19	0.58	0.94	1.21
p-value	0.247	0.032	0.165	0.005	0.005	0.000
N.Obs.	75	91	102	112	115	115

When we compared SSPs from the no information condition with actuarial calculations of survival prospects we noticed that on average, respondents underestimate their chances of living to earlier target ages. The tendency to underrate survival and overrate mortality compared with actuarial data does not reverse until much older target ages, when we see males especially underestimating their chances of dying (Figure 2). We expected that giving people accurate

information about their cohort and family survival would result in a reduction in bias, so that if respondents processed information correctly, they should report more optimism about surviving to nearby target ages. On the contrary, except in a few cases, more information actually aggravated pessimistic biases. This raises the question of what drives the increased pessimism we see, especially among Dutch respondents. Two possibilities are i) that giving people information as probabilities and percentages causes confusion and results in lower accuracy and or ii) that information about death primes a generally pessimistic psychological state that is displayed in the reports of survival expectations.

5.3 Information conditions, numeracy and confusion

Giving respondents who are not very numerate information about percentage rates of survival could cause them to become confused, instead of helping them understand. We tested the numeracy of all respondents in both surveys using a three question scale testing proportions, percentages and probabilities, developed by Lipkus et al. (2001), that has been applied in many settings among educated populations. Dutch respondents gave more correct answers than Australian respondents, but numeracy rates were not high in either group. Of the Dutch respondents, 56.43% got the first question correct; 53.56% got the second question correct; 47.43% got the third question correct and 36.93% got all three questions correct. Of the Australian respondents, 61.80% got the first question correct; 47.61% got the second question correct; 36.27% got the third question correct and 30.81% got all three questions correct. It is worth recalling that the third question, with the lowest proportion of correct answers in both samples, tested understanding of probabilities.

However, low numeracy does not fully explain the puzzling responses to information about longevity. SSPs of the most numerate Dutch respondents in the "live to" frame did not change significantly after they read the cohort or ancestor information. Then again, one could interpret no change as an improvement on the significantly pessimistic average revisions of the whole sample. In the "die by" frame, the responses of numerate Dutch respondents were again steady after new information, and some people in this group revised their estimates positively rather than negatively. Numerate Australians in the "live to" frame revised their expectations of survival to target age 75 significantly upwards, and the same was true to some target ages for respondents in the "die by" frame, although revisions were not consistently positive.

We can also identify a group of respondents who became more confused after being given

new information. We created a dummy variable indicating whether respondents gave a valid 0-10 answer to the SSPs in the no information condition but then answered "don't know" or "do not want to say" after new information in the three conditions. For the Dutch sample, we identified 68 respondents in the "live to" frame and 90 in the "die by" frame, or 158 confused respondents. A probit analysis on this group showed that older respondents were significantly more likely to become confused but that numerate respondents were significantly less likely to be confused. The same analysis on the Australian sample identified 32 people in the "live to" frame who became confused after new information, and 44 in the "die by" frame, for a total of 76 confused respondents. Again we estimated a probit model using demographics to predict membership of this group, and found that highly numerate people were significantly less likely to be confused. We conclude that higher numeracy does help people process new information, or least helps them avoid mistakes and confusion.

Psychological biases and unwillingness to entertain thoughts of one's own death are other explanations for low rates of revision and increased pessimism in the survey sample. The pessimism of SSPs to younger target ages and optimism to older target ages could be due to a tendency to underweight large probabilities and overweight small probabilities (Kahneman and Tversky, 1979). Misunderstanding the effect of skewness (Tversky and Kahneman, 1972) or the probability of conjunctive events can also bias subjective probability estimation (Bar-Hillel, 1973; Tversky and Kahneman, 1974).

Psychological studies show that most people are unwilling to plan for, or even contemplate, their own death (Kastenbaum, 2000). In fact research into mortality salience shows that conscious or unconscious thoughts of one's own death affects a wide range of behaviors and attitudes, and induces strategies designed to delay or distance death (Burke et al., 2010). Respondents in the information conditions of our survey receive information that primes them to think about their own cohort or family mortality in ways that are likely to bring their own death to the front of mind. This reminder might induce pessimism or paralysis in the same way that Payne et al. (2013) observed when they reviewed the thoughts of respondents in the "die by" frame of their own study. Salisbury and Nenkov (2014) showed that such negativity towards decisions that remind people of their death could partly explain individual's unwillingness to purchase life annuities, so could also be influencing decisions here. We observe that that increased pessimism is more marked for respondents who are assigned to the "live to" frame in our study. The first SSP questions directed to this group would prime them to think more about living than

dying. When they then went on to read cohort and/or ancestor information in the conditions, they might have been more startled by uncomfortable thoughts about personal mortality than respondents in the other frame. In the next section, we go on to assess the impact of subjective survival expectations in the treated and untreated samples on opinions about retirement income regulations and savings.

6 Subjective survival expectations, savings and entitlements

Governments around the world, including the governments of The Netherlands and Australia have been increasing the ages at which citizens can start receiving public pensions. In both countries, eligibility ages for the public pension are increasing from 65 to 67 years, with further increases likely in the future. An accurate understanding of longevity among the voting population is needed if governments are to find the public support to enact changes to pension entitlements. Here we evaluate whether subjective survival expectations predict respondents' agreement with increasing eligibility ages for public pensions, and whether getting information about cohort or familial survival makes a differences to opinions.

As a check on whether respondents to our survey care about pension and retirement issues at all, we asked respondents to consider a list of public policy issues and choose three areas that mattered to them most, and three that mattered to them least, with the option of saying that none of them mattered. We chose the public policy areas by reviewing major newspapers in each country during the period of interest. Remarkably, nine of the ten areas were issues of concern in both countries, but we substituted the Regulation of Problem Gambling in Australia for Marijuana Tourism in The Netherlands survey. The ten alternative issues and the percentage of times that each was chosen as most or least important are reported in Table 7. Regulation of retirement incomes and pension eligibility were both moderately important issues, below youth unemployment and health care, but above immigration and cycleways.

Table 7: Relevance of alternative issues

	Most relevant		Least relevant	
	NL	**AUS**	**NL**	**AUS**
Youth unemployment	53.36	39.85	7.86	15.24
Paid parental leave	7.30	15.28	43.00	56.10
Age pension eligibility age	21.33	39.66	17.61	13.63
Health care	86.48	77.96	1.17	7.02
Regulation of retirement income	19.78	23.64	21.47	22.45
Clean energy policy	28.54	28.05	25.10	29.01
Marijuana tourism (NL)	3.48		49.12	
Regulating problem gambling (AUS)		5.78		54.40
Cycle ways in urban areas	3.53	5.55	66.55	65.65
Terrorism and international security	50.44	7.81	6.49	14.32
Immigration	16.67	22.81	32.78	22.13
N.Obs.	2,123	2,178	2,123	2,178

Having established that most respondents thought that retirement income and pension policy were moderately important public policy issues, we then modelled the effect of initial and updated SSPs on their views. We estimated ordered probit models where the dependent variable was an ordered response of "disagree", "neither agree nor disagree", or "agree" with the statement that the pension age should increase with life expectancy. Explanatory variables were the individual's SSP to target age 75 (*SSP75*) and to target age 100 (*SSP100*), an indicator variable taking the value of one if the individual answered all the numeracy questions correctly or zero otherwise (*Numerate*), net household income (in '000s) (*Income*), an indicator taking the value of one if the individual is female, and zero otherwise (*Female*), the individual's number of children (*Children*), the individual's current age in years (*Age*) and the individual's age squared (Age^2), an indicator variable taking the value of one if the individual answered "don't know" or refused the SSP task, or zero otherwise (*Confused*) and an indicator variable taking the value of one if the individual was assigned to the "live to" frame, or zero if assigned to the "die by" frame (*Live frame*). We report the marginal effects of each of the explanatory variables on the probability that an individual *agrees* with increasing the pension eligibility age for the no information control and for each of the information conditions.

Estimates for the Dutch sample reported in Table 8, top panel, indicate that individuals who are more optimistic about their near-age survival are slightly more likely to support an increasing pension eligibility age: an increase of 1 (or a 10 percentage point increase) in the respondent's subjective expectation of surviving to age 75 raises the probability of agreement by

0.6 percentage points (panel 1, column 1). Getting information about the survival of your cohort (panel 1, column 2) raises this marginal effect to 0.9 percentage points. However SSP75 is not relevant when respondents received ancestor survival information. The strongest influence on agreement was numeracy: respondents who answered all the numeracy questions correctly were between 6 and 19 percentage points more likely than respondents who answered the questions wrongly to agree with an increasing pension age, and for three of the four condition groups, a higher household income also made agreement more likely.

Survival expectations were weakly related to savings intentions. Estimates for the Dutch sample, reported in Table 9, top panel, show that respondents in the initial (no information) sample who have more optimistic expectations of survival to age 75 are more likely to agree that expecting to live longer would induce them to save more, though the probability of agreement increases by only 0.4 percentage points for each 10 percentage point increase in survival expectations, and this effect is insignificant in the condition samples. Females, people with children and the highly numerate respondents expressed the view that expecting to live longer would not induce them to save more, and the effects are significant across two of the three information conditions. Women and people with more children might feel that they have less discretionary income available to save, regardless of life expectancy. These findings confirm earlier results in Post and Hanewald (2013) for 12 European countries. In addition, Dutch respondents are well protected against longevity by public and occupational pension annuities, and are therefore less likely to worry about an extended lifetime. Numerate respondents possibly have a better understanding of the longevity protection they already have in the pension system, or already have a plan in place to deal with the risk of longevity.

Results of the same estimations using Australian responses have some interesting differences and similarities (Table 8, bottom panel). First, we find that as Australians become more optimistic about very old age survival they are more likely to agree with increasing pension eligibility ages. The estimates in row 2, column 1 imply that a 10 percentage point increase in *SSP100* increases the likelihood of agreeing with a rising pension age by 0.8 percentage points. Rates of dependence on the public pension in Australia are higher at older ages because of asset and income means-testing that reduces the number of eligible retirees in the 65-75 years group when wealth is highest. In addition, Australians who expect to live to a very old age might be more worried about the sustainability of the public pension, since recent commentary in the media from government and industry has emphasised the increasing demands of the pension

on the government budget. However the effect is not significant when estimated on responses from the information conditions. Australian respondents with higher household incomes were more likely to agree that the pension age should rise. Means testing ensures that higher income respondents will probably receive smaller payments, and have less lifetime wealth to lose as the eligibility age increases. By contrast, women, who accumulate less retirement savings on average, disagree with increasing the pension age, since the decrease in lifetime wealth associated with waiting longer for the public pension is much higher for them than for males who have higher average accumulations.

Annuitization is not automatic in the Australian retirement savings (superannuation) system as it in in The Netherlands, and very few Australians choose to purchase longevity insurance voluntarily (Iskhakov et al., 2015). It follows then that Australian respondents who are optimistic about survival do agree with the need to increase savings if they expect to live longer, because most people self-insure against a longer life rather than purchasing an annuity. Results in Table 9, bottom panel, show that a ten percentage point increase in SSP75 increases the likelihood of agreement with increased savings by between 0.6 and 1.5 percentage points, and the effect is significant across the information conditions. High numeracy decreases the likelihood of agreement in two of the four models, possibly because numerate respondents already have a plan in place to manage longevity risk and do not expect to need to save more.

Table 8: Marginal effects of covariates on agreement with increasing pension age

NL	**No info**	**Cohort**	**Ancestor**	**Cohort & ancestor**
$SSP75$	0.006**	0.009**	0.005	0.004
	(0.003)	(0.004)	(0.004)	(0.007)
$SSP100$	-0.002	-0.003	-0.001	0.000
	(0.004)	(0.004)	(0.004)	((0.007)
$Numerate$	0.084***	0.070*	0.064**	0.186***
	(0.025)	(0.036)	(0.031)	(0.056)
$Income$	0.024***	0.025**	0.039***	0.029
	(0.008)	(0.012)	(0.010)	(0.020)
$Female$	-0.029	-0.052	-0.035	0.072
	(0.025)	(0.035)	(0.030)	(0.057)
$Children$	-0.018	-0.019	-0.034**	-0.005
	(0.012)	(0.017)	(0.014)	(0.027)
Age	0.000	-0.013	-0.002	-0.008
	(0.008)	(0.010)	(0.009)	(0.021)
Age^2	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)
$Confused$	-0.013	0.033	0.051	0.129
	(0.052)	(0.062)	(0.057)	(0.087)
$Liveframe$	-0.050**	-0.044	-0.057	0.023
	(0.024)	(0.050)	(0.041)	(0.076)
No. Obs	1,306	639	831	215
AUS	**No info**	**Cohort**	**Ancestor**	**Cohort & ancestor**
$SSP75$	0.001	0.001	0.006	-0.001
	(0.022)	(0.004)	(0.004)	(0.005)
$SSP100$	0.008***	0.003	-0.002	0.004
	(0.002)	(0.004)	(0.004)	(0.005)
$Numerate$	0.03	-0.039	0.074**	0.005
	(0.022)	(0.037)	(0.034)	(0.043)
$Income$	0.009**	0.014***	0.012**	0.020***
	(0.003)	(0.005)	(0.005)	(0.006)
$Female$	-0.169	-0.154***	-0.124***	-0.094**
	(0.020)	(0.033)	(0.032)	(0.041)
$Children$	0.016	0.028*	-0.037**	-0.032*
	(0.009)	(0.015)	(0.015)	(0.020)
Age	-0.006	-0.006	-0.016*	-0.003
	(0.005)	(0.009)	(0.009)	(0.011)
Age^2	0.000	0.000	0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)
$Confused$	-0.023	0.103	-0.153	-0.066
	(0.062)	(0.091)	(0.105)	(0.110)
$Liveframe$	-0.000	0.039	-0.050	-0.028
	(0.022)	(0.041)	(0.041)	(0.043)
N.Obs.	1,688	643	619	411

Table 9: Marginal effects of covariates on agreement with increased saving

NL	**No info**	**Cohort**	**Ancestor**	**Cohort & ancestor**
$SSP75$	0.004*	0.002	0.004	0.001
	(0.002)	(0.003)	(0.003)	(0.005)
$SSP100$	0.002	0.003	0.001	0.004
	(0.003)	(0.003)	(0.003)	((0.005)
$Numerate$	-0.084***	-0.025	-0.065***	-0.030
	(0.018)	(0.025)	(0.023)	(0.041)
$Income$	0.009	0.009	0.004	0.002
	(0.006)	(0.008)	(0.007)	(0.014)
$Female$	-0.044**	-0.054**	-0.066***	-0.036
	(0.018)	(0.024)	(0.022)	(0.040)
$Children$	-0.021**	-0.022*	-0.026***	-0.013
	(0.008)	(0.011)	(0.010)	(0.019)
Age	0.001	0.001	-0.001	0.021
	(0.005)	(0.007)	(0.007)	(0.014)
Age^2	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)
$Confused$	0.001	0.108	0.019	0.060
	(0.037)	(0.043)	(0.041)	(0.062)
$Liveframe$	-0.010	0.002	-0.004	-0.050
	(0.018)	(0.034)	(0.029)	(0.054)
No. Obs	1,306	639	831	215
AUS	**No info**	**Cohort**	**Ancestor**	**Cohort & ancestor**
$SSP75$	0.006**	0.008**	0.009**	0.015***
	(0.002)	(0.004)	(0.004)	(0.005)
$SSP100$	0.002	0.001	0.002	0.001
	(0.002)	(0.004)	(0.004)	(0.005)
$Numerate$	-0.069***	-0.053	-0.082***	-0.016
	(0.023)	(0.038)	(0.037)	(0.046)
$Income$	0.000	-0.003	0.004	-0.007
	(0.003)	(0.005)	(0.005)	(0.007)
$Female$	-0.040*	-0.006	-0.007	-0.030
	(0.021)	(0.035)	(0.036)	(0.045)
$Children$	0.001	-0.008	0.026	0.008
	(0.009)	(0.015)	(0.016)	(0.021)
Age	-0.006	-0.001	-0.013	0.003
	(0.006)	(0.009)	(0.010)	(0.012)
Age^2	0.000	0.000	0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)
$Confused$	-0.026	0.066	0.004	0.170
	(0.063)	(0.090)	(0.105)	(0.117)
$Liveframe$	-0.034	0.006	-0.081	-0.090*
	(0.023)	(0.041)	(0.044)	(0.047)
N.Obs.	1,688	643	619	411

7 Conclusions

International evidence shows that subjective estimates of life expectancy are too low. Average expectations of survival to younger ages are too pessimistic and at older ages are too optimistic, with women and younger cohorts showing the largest deviations from actuarial observations and forecasts. Individuals who are mistaken about their chances of survival at older ages are likely to be poorly prepared for retirement, to misjudge decisions about longevity and care insurance and mis-manage wealth decumulation. At the same time, governments responsible for regulating retirement savings systems are anticipating heavy demands on revenues as populations age, and are increasing eligibility ages for pensions. Individual welfare and pension system sustainability depend on accurate planning for longevity, so can biases be easily corrected by giving people accurate longevity information?

In this study we collect subjective survival expectations from samples of over 4000 Dutch and Australian individuals before and after they are given information about their systematic (cohort) and idiosyncratic (same-sex parent or grandparent) survival. We divide the sample randomly between a "live to" and "die by" frame and collect expectations as SSPs to a range of target ages and via confidence intervals around a median expected lifetime. We expect that people will update their subjective expectations to incorporate new longevity information, so that on average they should move closer to actuarial projections. At the same time, we anticipate that, consistent with earlier studies (Payne et al., 2013), respondents will give more optimistic expectations in the "live to" than the "die by" context. Our findings can be summarised as follows:

- Dutch and Australian respondents report untreated survival expectations that are pessimistic to younger target ages and optimistic at very old ages, and more biased among women than men, consistent with earlier studies.

- Giving respondents cohort and ancestor survival information did not generally result in de-biasing. Dutch respondents in the "live to" frame became significantly more pessimistic after receiving new information and respondents in most other conditions did not update their expectations significantly. Australian women updated their expectations to target age 75 and target age 95 in the expected direction. Respondents with low numeracy were more likely to become confused by the new information.

- Framing effects vary as the mode of reporting probabilistic expectations changes. Framing

effects on SSPs were significant and large, with more pessimism in the "die by" frame, as expected. However median lifetimes reported by Dutch respondents were the same between frames but were lower in the "die by" than in the "live to" frame among Australian respondents, as expected. Confidence intervals given by Dutch respondents in the "die by" frame were significantly wider, suggesting that the framing effect showed up in the second moment.

- Individuals' expectations of survival significantly influenced their views on pension eligibility ages, but effect sizes were very small. Numerate and higher income people were also more likely to agree to increasing pension ages. Optimistic expectations of survival were significantly related to savings planning among Australians, where most retirees do not purchase longevity insurance, so need to manage their own longevity risk.

In general, we conclude that simple programs that aim to educate people about longevity are unlikely to result in much improvement. In fact, the intervention tested here in many cases made things worse. Individuals with higher numeracy are more able to absorb facts about longevity, and are less prone to confusion, but for many of our respondents, reading about the deaths of their friends and family evoked more pessimism than before. We confirm that the challenges of presenting probabilistic information to unsophisticated decision makers should not be underestimated. Policy makers who want to garner support for sustainable retirement policy need to give careful thought to the way that messages are given to the general population.

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