Longevity Pessimism, Misinformation, and Pension Choice [*]

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Abstract

To determine the value of a pension, individuals need to consider their survival risk. In this paper, I first elicit survival probabilities for a broad set of target ages, using a representative panel of the 18-70 year-old Swiss population. I document a systematic survival belief bias, which is the stylized fact that individuals underestimate their survival probabilities (compared to actuarial life tables). Then, I show that incorrect information about longevity in general is a substantial component of this bias. Next, I implement an incentivized experiment that requires subjects to make risky pension choices, in which payoffs are not affected by participants' own longevity. I find that longevity pessimism induces earlier and less risky choices about the timing of pension benefits, under annuity or lump-sum pension schemes. Finally, I show that happiness and satisfaction have an indirect effect on pension choices through the channel of longevity pessimism.

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1 Introduction

To determine the value of a pension, which only pays off if the pensioner is alive, individuals need to consider their longevity risk, which is their probabilities of not being alive at future pension pay-off dates. Individual longevity variance is large, and driven in part by one's own longevity risk factors (family history, medical diagnoses, endogenous risky behavior), about which subjects have private information (Perozek, 2008). The realization of all individual longevity risk factors for a whole population is precisely the longevity information that actuarial life tables contain.

However, when asked explicitly, individuals consistently report beliefs about their survival probabilities that are lower than unbiased expectations from life tables. In other words, the typical individual thinks that he or she will die sooner than an average person (of the same age and gender). This characterizes a systematic *survival belief bias.* Part of this bias incorporates incorrect assumptions that individuals have about longevity in general (not only about one's own individual survival), which represents *longevity misinformation.* If the longevity misinformation component is removed from the survival beliefs bias, what remains can be defined accordingly as *longevity pessimism.* The latter could in parts explain some household finance puzzles (Heimer, Myrseth, & Schoenle, 2019), such as the 'annuity puzzle'[1] (Yaari, 1965; Peijnenburg, Nijman, & Werker, 2016), the 'under-saving puzzle'[2] (Skinner & Hubbard, 1994), or the 'old-age precautionary savings puzzle'[3] (Lugilde, Bande, & Riveiro, 2019).

In this paper, using experimental methods, I first explore the determinants of survival belief bias. Next, in novel results, I show that longevity misinformation is itself a substantial component of survival belief biases. Then, I evaluate the impact of longevity pessimism (survival belief without its longevity misinformation component) on financial decisions about the timing of pension payoffs. This experimental decision resembles the trade-offs individuals face – in the field – when deciding whether to delay the start of retirement for a few years, in exchange for an increase in pension payoffs, as they would then spend a smaller fraction of their remaining life expectancy collecting pension benefits and a larger fraction making contributions instead. However, in my experimental

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[1] "Why people do not buy annuities?"

[2] "Why people invest so little for retirement while earning labor income?"

[3] "Why people withdraw money too slowly from their investment accounts when they are very old?"

setting, the individual longevity risk of participants does not affect – by design – the risks to their payoffs. The results show that longevity pessimism leads to choices for earlier (and less risky) pension payoffs. Finally, I identify that personal happiness and satisfaction have an indirect impact on pension choice, through the channel of longevity pessimism, as happy subjects are less pessimistic about their longevity and choose later (riskier) pension payoffs.

To elicit survival beliefs, I employ an established procedure that asks subjects to assess their chances of being alive at different forward-looking target ages. I use a sample with a broad age range (18-70 years) of residents of Switzerland. Using sets of many survival beliefs for each individual allows the construction of fine-grained and smoother survival curves for each individual, extending the methodology of Dormont et al. (2018) and Wu, Stevens, and Thorp (2015). This also allows for more variation of subject age and thus of survival horizons whose probabilities subjects are asked about. My elicitation procedure contrasts with most studies on the longevity belief literature, which use coarse measures from retirement panels restricted to older subjects, usually eliciting survival beliefs only for nearer horizons (forward ages around 10 or 25 years ahead only).

Subjects consistently underestimate their survival probabilities at younger target ages. For example, the average woman (man) in the sample has an actual probability of living up to 70 years of age of 92.6% (88.2%) according to life tables,[4] but reports beliefs with a subjective probability of only 83.0% (82.3%). However, the seemingly small underestimation of survival probabilities until younger target ages (50 to 70 years) is critical. Because survival in any discrete period (one year) is conditional on having survived from birth until that period, underestimating survival probabilities to younger ages has a large impact on remaining life expectancy, as implied by those distorted probabilities.

In contrast, subjects vastly overestimate their survival to very old ages (beyond 90 years). Both women and men report average subjective probabilities of living up to 100 years of age of 14.2%, while actual unbiased probabilities from life tables are only 3.4% and 1.4%, respectively. Actuarial probabilities of someone living until age 70 are large, but the probabilities of someone living up to age 100 are small. If subjects were to make financial plans for retirement based on life expectancy implied by distorted survival probabilities, in the pattern described above, their savings

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[4] This is the average probability considering the age distribution of subjects in the sample at the time of elicitation, not the probabilities at birth.

and investment outcomes would be impacted more by their underestimation of survival during the early phase of retirement than by their overestimation of survival chances until very advanced ages.

These findings contribute to the literature on subjective survival beliefs, adding to the body of evidence that the distortion of survival probabilities strongly depends on target ages. They also strengthen the methodological case that measures of survival beliefs bias that take only focal estimation of longevity (i.e., simply asking subjects until what age they think they will live) conceal strong underestimation of survival probabilities to younger target ages and overestimation to older target ages, which partially compensate each other over the lifetime.

In the following step, I elicit subjects' beliefs about the survival of an average person of their same age and gender. Survival beliefs about oneself incorporate private information subjects have about their own longevity risk factors, but these should not affect survival beliefs about strangers. However, the differences observed between both sets of beliefs (about oneself and the average person) are large. The women (men) in the sample assess that an average Swiss woman (man) has a survival probability of 82.2% (80.2%) up to age 70. In absolute terms, survival probabilities about the average person deviate only 0.8 (2.2) percentage compared to subjective survival probabilities about oneself, but deviate 10.4 (8.0) percentage points from unbiased probabilities (from life tables).

Individuals may have private information on their *own* longevity risk factors. Previous studies found that individuals recognize the impact of salient medical and health events on their own longevity (Bissonnette, Hurd, & Michaud, 2017; Bell, Comerford, & Douglas, 2020; Hurd & McGarry, 2002), but not necessarily of the background impact of their risky endogenous behavior such as smoking (Hurwitz & Sade, 2020). Individuals might even have distorted perceptions about the impact of these individual risk factors on their own life expectancy (Heimer, Myrseth, & Schoenle, 2019), or be generally pessimistic about any risk that affects them personally.

However, these mechanisms should not affect subjective beliefs about the survival of an average person. Therefore, I assign the systematic bias of underestimating the survival probabilities of strangers – the 'average person' – to longevity *misinformation* in a broad sense. This does not concern one's own survival and the longevity risk factors that affect the person individually, but rather the lack of knowledge, skewed perceptions, and/or distorted beliefs about everyone's longevity.

The characterization of longevity misinformation is a contribution of this paper to understanding the formation of individual survival beliefs. Longevity misinformation can be incorporated into any assessment that individuals make about their own survival relative to that of an average person. It may be an additional mechanism that drives heterogeneity in household financial decisions throughout the life cycle, complementing recent studies that analyze household responses to shocks in longevity risk factors (Kvaerner, 2022).

Individual survival belief biases for different target ages can be aggregated into a measure of longevity pessimism. It reflects one's overall attitude regarding his or her own survival with respect to life tables, after accounting for, and partially removing, the impact of longevity misinformation and private longevity risk factors, from the present until a given target age. The effects of longevity pessimism and private longevity information could attenuate each other[5] with respect to their impact on life expectancy. They are also difficult to disentangle from each other in empirical studies of field data. Analysis of financial decisions in the life-cycle (Browning & Crossley, 2001) in the field, with stochastic longevity (Groneck, Ludwig, & Zimper, 2016; Cocco & Gomes, 2012) is further complicated by the possible presence of bequest motives (Ameriks et al., 2011; Kvaerner, 2022; Inkmann, Lopes, & Michaelides, 2011).

Within compulsory-participation pension schemes (found in most OECD countries), neither longevity pessimism nor private information on longevity risk factors matters. When aggregated for large populations (in life tables), the average survival probabilities have little short-term variance.[6] This facilitates actuarial pricing of pensions, aimed at a representative individual of the population involved, while forcing everyone to pool and share their individual longevity risk. The existence of mandatory pension schemes further complicates the empirical analysis of the formation of longevity beliefs inferred from voluntary individual retirement investment decisions. In practice, for most individuals currently living in OECD countries, the vast majority of their retirement savings, investment, and subsequent drawdown is implemented through predetermined mandates

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[5] For example, an individual who has a serious known medical condition likely to reduce her life span compared to an average person, yet overestimates her survival probabilities.

[6] In the long-term, a process known as *macrolongevity drift* becomes relevant. It concerns the epoch changes in expected immediate (one-year) survival probabilities for the same chronological ages. For example: a Swiss man of age 60 in 2022 is more likely to survive one additional year than a man of age 60 in 1975 because medical science is better equipped to treat certain diseases now, road safety has improved, and smoking rates have decreased.

prescribing highly regulated schemes.

To address some of these limitations, I investigate the role of longevity pessimism in an experimental task that involves simulated risky pension choices[7] (similar to Fatas, Lacomba, & Lagos, 2007). Subjects make choices about the timing of pension payoffs, for which they need to consider termination probabilities over multiple periods. In my experimental setup, longevity has no impact on the resolution of uncertainty (termination probabilities) for the participants' payoff in the task. Therefore, private information on longevity risk factors cannot improve subjects' assessment of their risk within the task.

My results show that the more pessimistic subjects are about their own longevity, the earlier (and less risky) their pension payoff choice is. Moreover, subjects delay their pension choice when the benefits are paid as lump sum, instead of a fair-priced annuity. Introducing a 'pessimistic annuity', priced as if the actuarial probabilities were weighted according to Tversky and Kahneman (1992), induces earlier pension choices than the fair-priced annuity, but the treatment effect is small.

Such findings offer two different contributions to the literature. I provide evidence that longevity pessimism is associated with the evaluation of risky financial choices on retirement, beyond considerations of whether subjects are informed about longevity in general or about their own individual longevity risk factors in particular. I also contribute to the literature on annuitization puzzles with further evidence that annuities attract less risk taking on pension choices than lump-sum payoffs and that longevity pessimism affects choices under both pension frameworks.

In further results, I also find that idiosyncratic happiness (Becker & Trautmann, 2022) can influence survival beliefs, as unhappy subjects may assume longevity-pessimistic beliefs. In the field, happiness is plausibly affected by many common drivers of longevity, such as health status or self-destructive behaviors, which further bolsters the case for the use of experimental elicitation that can reduce or remove these endogenous factors from affecting the termination risk in a simulated task.

Finally, I examine indirect effects of the individual happiness and satisfaction index on pension

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[7] The experimental task is significantly non-contextual, in the sense that it refrains from using terms such as 'pension', 'retirement' or 'benefits' on its interface or instructions.

decision through longevity pessimism. I find that longevity pessimism confounds 52% of the total effect of happiness on pension decisions in a model that also accounts for the effects of change in health status.

Taken together, the results of this paper also have some empirical and policy implications. Because longevity misinformation comprises a significant part of survival belief bias, there may be potential to improve individual decision-making on financial decisions about retirement through better information or financial education of individuals making analogous decisions in the field. The age-dependent patterns of (over)underestimation of survival at younger (older) target ages and the effect of longevity pessimism on the timing choice of pension benefits suggest that removal of institutional constraints in the design of pension schemes should proceed with caution. The underlying mechanisms that make individuals longevity-pessimistic also affect decisions they make regarding risk-taking in pension payoffs, while, as noted, they are also substantially misinformed about longevity in general. In the field, this could result in the promotion of reforms to pension schemes that, inadvertently, exacerbate certain individual inefficient investment behaviors with respect to household welfare (under-saving for retirement by underestimating the financial needs in old age) or moral hazard for societal welfare programs (accelerated decumulation of retirement investments as individuals outlive their savings and subsequently rely on public assistance).

The remainder of the paper is organized as follows. In Section 2, I introduce the framework of pension decisions with longevity risk, define survival biases and longevity pessimism, and introduce the experimental setup. The main results are presented in Section 3, with additional analysis and robustness checks in Section 4. In Section 5 I discuss the results and conclude. This experiment was pre-registered with AsPredicted at Wharton Credibility Lab.[8]

2 Experimental Setup, Design and Data

In this section, I introduce the standard actuarial model for survival (Subsection 2.1), followed by survival beliefs measures, their biases and a model of longevity pessimism (Subsection 2.2). I then present the experimental design of the main pension choice task (Subsection 2.3), and briefly

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[8] AsPredicted #107473

elaborate on the happiness and satisfaction index and its components (Subsection 2.4). Then, in Subsection 2.5, I explain in detail the experimental procedures that I adopt, and in Subsection 2.6 I discuss the simple univariate characteristics of my sample and present information on the recruitment, attrition, and general performance of the participants.

2.1 Longevity Beliefs and Biometric Returns

Using discrete measures, an average individual of current age a and sex[9] g has an expected probability $\zeta_{a,g,f}$ of dying between any current or future age $f_t \geqslant a$ and $f_t + 1$.[10] Then, the probabilities that an individual survives between his current age and any target[11] age $t > a$ (the cumulative survival probabilities) between a and t are:

$$\varphi_{a,g,t} = \prod_{f=a}^{t-1} \left(1 - \zeta_{a,g,f}\right) \tag{1}$$

The remaining life expectancy (the conditional expected lifespan from t onwards), in years,[12] of an individual of gender g from any target age $t > a$ onwards can be thus computed as:

$$e_{a,g,t} = \sum_{t}^{\bar{T}} \varphi_{a,g,t} \tag{2}$$

whereas $\bar{T}$ is the upper absolute limit of human longevity when $\zeta_{a,g,\bar{T}} = 1$, or, in other words, the maximum age a person of his or her gender can reach. The special case of the current remaining life expectancy (when $t = a$) is $e_{a,g} = \sum\limits_{t=a}^{\bar{T}} \varphi_{a,g,t}$.

Let a *pension* be defined as a financial product whose cash flows are contingent on its individual holder being alive at each scheduled payoff date.[13] The present value of this pension must account

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[9] The demographic 'life tables' that consolidate aggregate longevity expectations for large population groups are commonly segregated by sex, and usually do not account for non-binary groups (identifying themselves other than males or females) due to small group sizes and lack of historical data.

[10] This implies, for instance, that two women, of current ages 32 and 57, might have different expected one-year probabilities of dying at age 74 due to the process of macrolongevity drift.

[11] For clarity, I henceforth use *target age* to designate a set of future ages, expressed in chronological years (and not as offsets from current age), over which I analyze subjects' probabilities and respective beliefs.

[12] Assuming that each unit of f is also one year.

[13] For simplicity, I assume one payoff per evaluation period. Furthermore, for the purposes of all research questions in this study, it is not relevant whether pension payoffs are nominally fixed, unit-linked or inflation-indexed.

for the probabilities that its holder will not be alive to collect some (or all) of the future payoffs. Because these survival probabilities are always smaller than one – for any target age – the present value of the cash flows of a pension is lower than the present value of a series of zero-coupon bonds with the same maturities as the pension payoff schedule. The cumulative impact of longevity on the present value of a single pension cash flow, between the present and the target age t, can be expressed as total *biometric returns*:

$$\nu_{a,g,t} = \frac{1}{\varphi_{a,g,t}} - 1 \tag{3}$$

Furthermore, assuming a constant nominal interest rate r per period, the implicit one-period total return rate r^* for a pension payoff due at t, aggregating both the interest rate and the biometric returns, can be defined as:

$$r^*_{a,g,t} = \left(\underbrace{\left(1 + \nu_{a,g,t}\right)^{\frac{1}{t-a}}}_{\text{annual biometric return}} \times (1 + r) \right) - 1 \tag{4}$$

Equation (4) shows that the impact of biometric returns on total pension returns, for any given maturity, is considerably affected by the current age of different subjects. As an example, let us consider two Swiss men of current – as of 2021 – ages 44 and 54 years old, and a single pension cash flow with 25-year maturity. Their unbiased cumulative survival probabilities – from life tables – until target ages 69 and 79 (at maturity for each) are 87.9% and 70.8%, and their annualized biometric returns would be 0.52% and 1.39%, respectively. If, instead, the valuation of pension cash flows concerned two Swiss men 10 years younger (34 and 54) with a maturity of 10 years longer (35 years), their annual biometric return would be 0.39% and 1.04%, respectively.

The impact of biometric returns on pension valuation is most important for middle-aged individuals and pension maturities around the turn of the first decade of typical retirement. Then, the discount horizon is short enough not to dilute the total biometric returns when capitalized on annualized rates, making the biometric returns relatively more important with respect to interest rates r in terms of discounting pension cash flows. Simultaneously, for middle-aged individuals, the correspondent cumulative survival probabilities are still high enough that survival is more likely than death, for subjects to actually collect their pension payoffs.

In this study, the Swiss life table from the Swiss Federal Statistics Office (SFSO) for 2021, compiled by the Human Mortality Database (Max Planck Institute for Demographic Research, University of California, & French Institute for Demographic Studies, 2022), as parameters of the expected actuarial (unbiased) longevity and probabilities of survival and mortality.

Although life tables offer pretty accurate estimates of longevity of large groups representative of their populations, subjects hold individual beliefs on their own survival probabilities that are different from the actuarial expectations (Bissonnette, Hurd, & Michaud, 2017; Wu, Stevens, & Thorp, 2015). These differences can arise from private information about one's own longevity risk factors (such as family history or personal health status), from idiosyncratic over- or underestimation of longevity, from misinformation about the distribution of survival probabilities, and from personal biases on how the subject assess risky prospects in general.

Individual (subjective) longevity belief measures comprise subjective *survival beliefs* and *mortality beliefs*, measured as probabilities; and subjective *life expectancy*, measured in years. Payne et al. (2013) show that a 'live until' framing of longevity – which elicits survival probabilities – reduces inconsistencies on belief elicitation, compared to a 'die by' alternative, which yields mortality probabilities.[14]

To elicit survival beliefs, I extend the mechanism proposed by Wu, Stevens, and Thorp (2015) to incorporate a wider span of chronological age of subjects (18-70 years old), and elicit more precise measurement of survival beliefs (on a scale with 99 discrete points) in order to build subjective survival curves less affected by coarse measurements of individual beliefs. Each subject i of current age a_i is asked "*What are your chances of being alive at age...*" as the prompt to input survival probabilities $\tilde{\varphi}_{i,t}$ for a set $\mathbf{F}$ of target ages that span five-year intervals:

$$\mathbf{F}_i = \{t_n \in (t_{n=1} = 50, t_{n-1} + 5, \ldots, 105) \,|\, t_n > a_i\} \tag{5}$$

Subjects younger than 50 input estimated survival probabilities for 12 target ages. Those older than 50 are elicited on fewer target ages, starting with the first target age that is higher than their current

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[14] This result is consistent is the premise that eliciting the less salient state – surviving another number of years – is less likely to attract probability distortions on reported beliefs than eliciting the salient event – dying.

age. The set of target ages is fixed with respect to specific chronological ages (50, 55, $\cdots$), instead of offsets from current age ($age+5, age+10, \cdots$) as in some previous studies. This means that stepwise implicit probabilities between target ages after the first are directly comparable between subjects. If all subjects are specifically asked about the probabilities of living from their current ages up to 80 and 85 years, it is trivial to calculate the implicit survival probabilities between ages 80 and 85 as $\frac{\tilde{\varphi}_{i,85}}{\tilde{\varphi}_{i,80}}$. This procedure also avoids heterogeneous elicitation sets where some subjects are asked beliefs about salient ages (e.g. 60, 65, 70 years) and others are not (e.g. 57, 62, 67, 72 years).

Survival probabilities are elicited on a 0.1-9.9 scale with 0.1 discrete increments. An information table explaining the scale is available on the same screen as subjects input their beliefs. Subjects choose the probabilities, using an interactive slider, for each target age, without defaults or preset values. In this way, this study uses a finer discrete scale (as in Dormont et al., 2018), instead of the usual coarse target age vectors from most previous studies. This reduces the potential impact of truncation and partial identification of probabilities (Bissonnette & de Bresser, 2018; Imbens & Manski, 2004; Kleinjans & Soest, 2014; de Bresser, 2019), in particular at younger target ages. Nonetheless, subjects might still input survival probabilities that are within the rounding interval to their actuarial expectations, when $\left(\varphi_{a_i,g_i,t}-0.005\right) \leqslant \tilde{\varphi}_{i,t} < \left(\varphi_{a_i,g_i,t}+0.005\right)$. In such cases, the input of the survival belief is replaced by the actual probability from the life table. Figure 1 shows a screenshot of the English-translated online elicitation interface.

PLACEHOLDER – **FIGURE 1**

Although most of the previous literature on survival belief bias considers only subjective beliefs about oneself $\left(\mathbf{F}_i^{own}\right)$ vis-a-vis their actuarial expectations from life tables, I also elicit two additional different sets of beliefs with different subject or object, for a total of three sets of probabilities $\mathbf{F}_i^{j}$ per subject, as explained below.

In the first additional set, subjects input their survival beliefs about an average person of the same age and gender[15] $\left(\mathbf{F}_i^{pop}\right)$. Deviations between this measure and those from life tables indicate misinformation about longevity risk in general, regardless of its source. Any private information that subjects may possess about their own longevity risk factors should not affect their assessment

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[15] For example, a prompt reads '*'What are the chances of a typical 23 years old Swiss woman still being alive at age ...*"

of the survival of an average person.[16] On average, these survival probability estimates for an average person should match the parameters of the life table.

The final set of beliefs concerns the survival beliefs of a subject's family and close friends about the subject's survival $\left(\mathbf{F}_i^{fam}\right)$, according to the subjects' expectations of them. Family and friends might be partially informed about the subject's longevity risk factors, such as family longevity history (how old did deceased relatives live or presence of hereditary diseases), endogenous risk behavior (whether the subject smokes) or health status (medical diagnoses well known to close associates of the subject). These beliefs provide a useful double-comparison reference point with respect to both the subject's survival beliefs about oneself and about an average person.

For simplicity, the sets of survival beliefs are hereafter simply referred to as *oneself (own)*, *average person (pop)* and *family (fam)*, respectively.

In the last step of elicitation of survival beliefs, subjects also provide a single focal point estimate of life expectancy, that is, their estimated age at death ("*To what age do you think you will live (in years)?")*, for the three sets of beliefs. This simpler elicitiation mechanism provides an alternative measure of longevity to be compared with life tables. Such focal subjective estimations are nonetheless unstable, as subjects tend to cluster their estimations around 'round' and 'salient' numbers, generating beliefs clustered at these salient ages. For this reason, when using life expectancy estimations, I take the implied values from survival beliefs instead.

2.2 Longevity Belief Bias Measurement

Taking the three sets of beliefs elicited on survival probabilities for each subject, I first calculate the survival biases between each set of beliefs, from their counterfactual probabilities of the Swiss life tables. As the probabilities are numerically bounded within $[0.01 - 0.99]$, while their actuarial expectations (from life tables) also vary substantially between the target ages, it is necessary to scale the deviations between subjective and actuarial parameters. Using the correspondent mortality probabilities from the beliefs $j = \{own, pop, fam\}$ elicited for each subject and target age, the

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[16] Eliciting probabilities of an archetype of same age and gender reduces the cognitive burden on subjects and, arguably, limits the potential impacts of any secondary bias from gender and/or age differences when subjects assess *relative* survival probabilities of other people.

survival belief scaling factors $\iota_{i,t}$ are obtained:

$$\iota^{j}_{i,t} = \frac{1-\tilde{\varphi}^{j}_{i,t}}{1-\varphi_{a_i,g_i,t}} \tag{6}$$

Each of these factors is the ratio of the implicit subjective mortality probability to the unbiased expectation from the life table. Hence, target ages other than the last (105 years) have elicited overlapping beliefs. For example, a woman of current age 45 can only survive up to age 70 if she first survives until 65 years old. Then, her belief in her survival probability up to age 70 $\left(\tilde{\varphi}^{own}_{i,70}\right)$ also contains expectation about her survival up to age 65 $\left(\tilde{\varphi}^{own}_{i,65}\right)$.

To obtain a comparable survival bias measure for each set and subject, accumulated until each target age, it is necessary to aggregate the implicit biases for each subject, to the extent that the scaling factors $\iota^{j}_{i,t}$ are not constant across target ages t within subject i.

Of particular interest is the fact that survival probabilities across $\mathbf{F}_i$ range from very high (in younger t) to very low (in very old t), while also including t for which $\varphi_{a,g,t}$ is moderate between both tails. The scaling factors of survival belief $\iota^{j}_{i,t}$ for younger target ages are sensitive to small absolute deviations, as $\left(1-\varphi_{a_i,g_i,t}\right)$ is small, but propagate over a long remaining life span, greatly impacting subjective remaining life expectancy. On the other hand, biased beliefs for very old target ages have only limited effects on remaining life expectancy, because subjects are unlikely to survive – for instance – up to age 100 anyhow. In addition, a comparable individual bias measure must account for the fact that subjects older than 50 (the first target age) have a variable number of target ages in their belief sets, and that the scaling factors are also sensitive to the subject's current age.[17]

Therefore, using these survival belief scaling factors, I calculate, for each subject, belief set $j = \{own, pop, fam\}$ and target age t, the natural logarithm of the average scaled survival belief factor for the target ages up to t, weighted by unbiased actuarial probabilities, and define the three

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[17] For example, a female subject of current age 48 has higher probability or surviving up to age 73 than a woman with current age 20, because the risk of that this individual dies between ages 20 and 48 (irrelevant for the older individual who already reached that age) is embedded in the cumulative survival probabilities between ages 20 and 73.

corresponding individual survival belief bias measures:

$$q^j_{i,t_n} = \ln \left[\frac{\sum_t^{t_n} \iota^j_{i,t} \times \left(1 - \varphi_{a_i,g_i,t}\right)}{\sum_t^{t_n} 1 - \varphi_{a_i,g_i,t}} \right] \tag{7}$$

Subjects with $q^j_i > 0$ are *pessimistic* about the survival belief j (oneself, average person or family), with respect to actuarial unbiased probabilities. Likewise, $q^j_i < 0$ indicates survival *optimism* at the individual level. Differences of q^j between subjects indicate their relative ratios of pessimism or optimism.

The measure q^{own}_i is analogous to the most common *longevity bias* as defined and analyzed by the existing literature, comparing the beliefs of subjects about their own longevity to the survival probabilities of life tables. As mentioned previously, this *oneself* bias comprises private information on factors that affect longevity and potentially a term that incorporates pessimism and optimism of the subject about his or her own longevity.

Alternatively, q^{pop}_i cannot incorporate any private information on subjects' own longevity risk factors. It measures the bias between a subject's survival belief of an average person of the same age and gender and the survival probability for this average person from the life tables. Consequently, the measure q^{pop}_i characterizes *longevity misinformation*, or incorrect assumptions that subjects have about longevity in a broad sense, not only about their own survival.

Following, q^{fam}_i can be assumed to embed partial information on one's own longevity risk factors, as previously discussed. If a subject believes that family and friends, who know the subject well, are as pessimistic as him or herself and assume that they have partial information on negative longevity factors about the subject, then it could be expected that $q^{own}_i > q^{fam}_i > q^{pop}_i$. Otherwise, q^{fam}_i will also incorporate differences on the expected pessimism of family and friends and the subject's pessimism about his or her survival.

Individual survival beliefs about oneself can also be scaled with respect to the subject's family and average person beliefs, allowing for comparison of these relative biases between subjects. For that purpose, I define the two additional survival bias measures, average-weighted by the actuarial unbiased probabilities as in Equation (7):

$$q^{own:pop}_{i,t_n} = \ln \left[\frac{\sum_t^{t_n} \frac{1-\tilde{\varphi}^{own}_{i,t}}{1-\tilde{\varphi}^{pop}_{i,t}} \times \left(1-\varphi_{a_i,g_i,t}\right)}{\sum_t^{t_n} 1-\varphi_{a_i,g_i,t}} \right] \tag{8a}$$

$$q^{own:fam}_{i,t_n} = \ln \left[\frac{\sum_t^{t_n} \frac{1-\tilde{\varphi}^{own}_{i,t}}{1-\tilde{\varphi}^{fam}_{i,t}} \times \left(1-\varphi_{a_i,g_i,t}\right)}{\sum_t^{t_n} 1-\varphi_{a_i,g_i,t}} \right] \tag{8b}$$

To quantify longevity *pessimism* as a comparable measure across subjects, regardless of their current age, I first regress the relative bias of oneself to family beliefs on the relative bias of oneself to the average person, longevity misinformation, age, target age, and gender, as follows:

$$q^{own:fam}_{i,t} = \alpha + \beta_1 q^{own:pop}_{i,t} + \beta_2 q^{pop}_{i,t} + \gamma_1 a_i + \gamma_2 t + \gamma_3 g_i + \mu_i + \varepsilon_{i,t} \tag{9}$$

and then use its predicted values for each subject and target age as the measure of longevity pessimism $\psi_{i,t} = \widehat{q^{own:fam}_{i,t}}$.

Finally, bias on survival beliefs could also be measured in terms of differences in implied partial life expectancy between the current age and each target age. Partial life expectancy $\widetilde{ex}^j_{i,t}$ is how many years the subject is expected to live from the present up to a given target age. Because individuals always have survival probabilities smaller than one between the present and any target age, in expectation they will accumulate fewer years lived between a_i and t than $t - a_i$.

From the life tables, the partial unbiased life expectancy $\overline{ex}_{a_i,g_i,t}$ is extracted from the probability mass function of individual survival. From the elicited beliefs on survival probabilities, the expected partial life expectancy $\widetilde{ex}^j_{i,t}$, for each subject, until any target age, for the belief sets $j = \{own, pop, fam\}$, is given by:

$$\widetilde{ex}^j_{i,t_n} = \begin{cases} \tilde{\varphi}^j_{i,t} \times (t - a_i) & \text{if } n = 1 \\ \widetilde{ex}^j_{i,t_{n-1}} + 5\tilde{\varphi}^j_{i_i,t} & \text{if } n > 1 \end{cases} \tag{10}$$

Then, I take three life expectancy bias measures $kex^{j}_{i,t}$ as the simple numerical difference between partial life expectancy (implicit from the probabilities elicited for $j = \{own, pop, fam\}$ and the unbiased parameter from the life table, as:

$$kex^{j}_{i,t} = \widetilde{ex}^{j}_{i,t} - \overline{ex}_{a_i,g_i,t} \tag{11}$$

Then, I also calculate the relative life expectancy bias measures, analogous to those of equations (8a) and (8b):

$$kex^{own:fam}_{i,t} = \widetilde{ex}^{own}_{i,t} - \widetilde{ex}^{fam}_{i,t} \tag{12a}$$

$$kex^{own:pop}_{i,t} = \widetilde{ex}^{own}_{i,t} - \widetilde{ex}^{pop}_{i,t} \tag{12b}$$

These life expectancy bias measures will be used for robustness checks. Like the $q^{j}_{i,t}$, $q^{own:pop}_{i,t}$ and $q^{own:fam}_{i,t}$ survival belif biases, life expectancy bias measures aggregate, at the individual level, different survival beliefs relative to benchmarks (from life table or a different set of beliefs between oneself, average person, and family). Contrary to the former, nonetheless, life expectancy bias does not weight distortion on beliefs that are measured, implicitly, serveral times for future target ages that have partially overlapping chronological spans – as previously noted.

2.3 Pension Payoff Choice

The main decision-making task of the experiment is the choice of a period (1-20) of an experimental life (round) to collect, start to collect or start paying pension payments. After answering questions on their longevity beliefs as described, subjects face experimental risk (termination probabilities), and there is no interest rate. Subjects make one choice per round, at its start. This task expands the design and treatment conditions used by Fatas, Lacomba, and Lagos (2007).

The termination probabilities are given by a random draw without replacement of virtual cards. Subjects start a round with a deck consisting of 19 green cards and one red card. At each period, a card is drawn: if the red card is selected, the round is terminated immediately; otherwise, the subject advances to the next period. This mechanism implies that a round cannot go past 20 periods (when the only remaining card would be the red one), the average experimental longevity is 10.5 periods (at the start of a round), the distribution of termination periods for subjects in a round is uniform, the one-period termination probabilities increase at each period (a process that mirrors the longevity dynamic of senescence),[18] and the marginal increase in termination probabilities across periods is monotonically positive.

There are four conditions on the treatment of the payoff structure. Their environmental parameters are shown in Table 1. In the baseline condition *Fair*, subjects decide when (period) to start collecting payoffs (in points). They keep collecting fixed payoffs every period until termination (i.e., until they draw the red card). For example, a subject that chooses period 11 will earn zero if terminated before period 11. Otherwise, the subject earns 303 points per period until a red card is drawn.

This structure resembles a life annuity pension, whose nominal payoff per period increases the longer the subject postpones the beginning of retirement (pension choice for later payoffs). As cumulative survival probabilities decrease in later periods, biometric returns increase substantially, so nominal payoffs become quite high, although the subject is not very likely to reach such periods before termination.

At the start of a round, nevertheless, the expected value of the option for any period is 1000 points. Therefore, subjects are making a risky choice with the same underlying expected value on 20 different prospects whose conditional termination risk realizations at their overlapping end-tails are identical.

PLACEHOLDER – **TABLE 1**

The *Pessimistic* condition has annuity payoff mechanics identical to those of *Fair*, but with distorted payoff values. I recalculate the actuarial probabilities as if subjects were engaged in probability weighting according to the probability weighting function of Tversky and Kahneman (1992). I use the average standard probability weighting coefficient for Swiss survey participants from Rieger, Wang, and Hens (2017). The weighted experimental cumulative survival probabilities s for each

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[18] At older ages, as a person gets one year older, his or her probability of surviving another 12 months decrease.

period p then become:

$$w\left[s_p\right] = \frac{\left(s_p\right)^{0.54}}{\left(s_p{}^{0.54} + \left(1 - s_p\right)^{0.54}\right)^{\frac{1}{0.54}}} \tag{13}$$

which are used to define the expected payoffs for this treatment condition. As seen in Table 1, the payoffs are higher than in the *Fair* condition until pension choice in period 10, and lower afterward. The expected values (discounted by unbiased probabilities) are now different between periods, being the highest at period 2 (1257 points), the lowest at period 20 (169 points), and higher than 1100 points (a 10% increase from the other treatments) for all periods 1 to 8.

If subjects are underweighting their high termination probabilities in the first periods, this modified set of payoffs should attract, on average, earlier pension choice. As well, on this condition the payoffs for low-probability very late periods are also substantially reduced (3377 points in period 20, instead of 20000 in the *Fair* condition).

In the *Lump-sum* condition, subjects earn a single payoff at their chosen period, as long as they have not been terminated before. Further realization of experimental survival after that period is irrelevant to his or her payoff in that round. Concentrated pension payoffs in lump sums can lead to a delay in pension choice (Fatas, Lacomba, & Lagos, 2007), as the cognitive burden of integrating a stream of uncertain payoffs is reduced. Furthermore, the salience of a large amount paid could attract subjects to take more risk when the realization is not contingent on the aggregation of present values that include later periods when survival probabilities are low. The expected values of the payoff of these conditions are identical to those of the *Fair* condition, that is, 1000 points for the choice of any period.

Finally, in the *Reverse* condition, the the subjects are given an initial endowment at the beginning of each round. They then need to make a stream of payments out of that endowment from their chosen period until termination, as if they were the issuers (instead of holders) of a life-annuity pension. The endowment (2000 points) is equal to twice the expected value of the payments, so the expected payoff value in all periods is the same as in *Fair* and *Lump-sum* (1000 points, after the expected payment of 1000 points from the endowment is made). In this condition, a subject becomes bankrupt (earning no variable payoff in that round) if the total payments he/she needs to make exceed the initial endowment. Bankruptcy is possible for all pension choices, except for period 1, if termination occurs too late. For instance, a subject whose reverse pension choice is period 10, with eventual termination at period 18, will have made 9 payments of 303 points each: a total of 2727 points that exceeds the initial endowment by 727. Only in a choice for period 1 or 2 would prevent bankruptcy in all possible cases (a subject that survives until the last period will have paid in total 1900 and 1995 points if he or she made a choice for period 1 or 2, respectively).

To the extent that subjects are loss-averse and treat payments out of their endowment as losses, but do not distort the implicit probabilities, they should on average make earlier pension decisions than in other treatments. Biometric returns, similar to those under *Fair* condition, should be less effective in inducing choices in later periods. Subjects can earn a maximum of 2000 points in *Reverse*, which is equivalent to the maximum payoff of the pension choice in period 1 for the condition *Fair*.

The termination probabilities in the task are completely unrelated to the subject's own longevity risk factors, as uncertainty on the payoffs of the pension choice task is resolved within a short experimental session. Even if the impact of these factors is weighted and distorted in terms of their probabilities (Heimer, Myrseth, & Schoenle, 2019), there should be no significant impact on pension choices in this task. If, however, subjects are longevity pessimistic for reasons unrelated to their expected information on longevity risk factors, and not entirely due to wrong information on longevity in general, then longevity pessimism could affect their pension choices in the task.

The treatment conditions on payoff structure present the same underlying decision problem: assessing cumulative survival probabilities in a risky prospect, and deciding a period for payoffs structured according to each treatment. This decision is analogous to the individual deciding whether to postpone or anticipate the start of retirement or the schedule of voluntary annuities. The conditions *Fair* and *Pessimistic* conditions require a subjective assessment of experimental survival probabilities for the maximum possible duration of a round (20 periods), since the expected payoffs lasts until the subject faces termination. The *Reverse* condition inverts the gain frame from accruing payoffs over multiple periods to a loss frame of spending down (possibly going bankrupt) from an endowment that is already the maximum possible payoff a subject can attain. The *Lump-sum* condition offers simple independent prospects in each period, which require a simpler assessment of survival probabilities only until the chosen period.

Importantly, this study is not primarily concerned with the treatment effects of each of these conditions. Instead, it focuses on whether the effect of longevity pessimism in pension decisions is robust to different payoff structures, that resemble different underlying optimization problems faced by individuals making voluntary pension decisions in the field.

2.4 Happiness and Satisfaction

Happiness, broadly defined (Frey & Stutzer, 2002), is correlated with several factors that drive longevity. It has an U-shaped pattern (Becker & Trautmann, 2022): higher at young and old age, lowest in middle age and could drive subjective longevity beliefs (Gimenez, Gil-Lacruz, & Gil-Lacruz, 2021). In summation, happiness can be a determinant of both longevity beliefs, while also being correlated with individual preferences that influence choice under risk, as in the pension choice task.

I ask the subjects five questions on happiness and life satisfaction, combining questions from the European Values and Satisfaction Survey by Sortheix and Lönnqvist (2014), and relevant theme questions from the Swiss Household Panel (FORS - Swiss Centre of Expertise in the Social Sciences, 2022). The questions concern overall happiness; and satisfaction with current life, personal life history, finances, and health.[19] All questions are measured on a scale of 1-10, at 0.1 intervals, and input with a slider with no default value.

As the expected correlation with these measures is relatively high, I use the first factor in a principal component analysis of the answers to these five questions (all on the same scale) as a *health and satisfaction index*. This reduced index is then used to evaluate how happiness and satisfaction, in a broader sense, could affect pension decisions, directly or indirectly, through the channel of longevity pessimism.

2.5 Experimental Procedure

The experiment consists of several self-contained individual tasks that elicit survival beliefs, the choice of pension payoffs, and a few sets of individual characteristics. Figure 2 illustrates the

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[19] A separate question inquires subjects on recent changes to their health.

sequence of tasks in the experiment.

PLACEHOLDER – **FIGURE 2**

After giving consent and providing demographic information, survival probabilities are elicited for each set of beliefs j (oneself, average person, and family) are elicited on single screens, which are identical except for changes in text that identify the relevant set.

The monotonicity of the beliefs in each $\mathbf{F}_i^j$ is enforced. Otherwise, a participant who informs a higher survival probability for an older target age than a younger one would imply survival probabilities greater than one between those ages. A participant receives an error message and a practical example at the first violation, and is excluded after a second.

An additional single screen asks participants to give focal (years) life expectancy estimations, in terms of age at death, for all sets.

The participants then answered questions about happiness and satisfaction and read the relevant instruction screens for their treatment. Instructions remain available throughout the rest of the main pension decision task, as clickable tabs at the bottom of each screen.

Before proceeding to the main decision, participants must pass a quiz of four questions on the basic mechanics and rules of the pension decision tasks. The instructions remain available for consultation during the quiz. Participants who do not correctly answer all quiz questions after two attempts are excluded from the experiment.

After passing the quiz, participants complete three rounds of the pension decision task. All the outcomes and randomization of the termination period in each round are independent of each other. In another study, a similar pension decision task with repeated rounds showed significant learning effects, especially from participants who are terminated before their chosen pension period (Bachmann et al., 2022). For this reason, this experiment does not have a standard trial round, relying instead on the quiz and subsequent exclusion criteria to ensure that participants know how the task works.

At the beginning of a round, participants make their pension decision, selecting one period out of

20 from a slider that, when moved, automatically adjusts feedback information on expected payoffs conditional on outcomes of the draw of red and green cards. Then, on the same screen, participants navigate through the draw period by period, until termination. A period-by-period recursive table is populated with payoffs accumulated in that round, if any. Once the round reaches termination (red card is drawn), a brief intermission screen is shown and participants move on to the next round.

One of the three rounds is selected for compensation, which participants do not know until the very last step of the session. However, they will know the payoffs of each round, based on their termination and pension decision. Therefore, the results of the next decisions could be potentially affected by the expected payoffs from the main task.

Then, participants complete the *"bomb" risk elicitation task* (BRET) – designed by Crosetto and Filippin (2013) – as implemented by Holzmeister and Pfurtscheller (2016), using a 8 × 8 matrix setup in a one-shot procedure. From its results, I extract the CRRA coefficients through numerical simulation. The BRET was selected for simplicity, the limited time required to complete it and for being more distinct – in structure and interface – from the pension decision task than the multiple choice lists (Holt & Laury, 2005) or risky investment allocation (Gneezy & Potters, 1997) task. This facilitates partial obfuscation to participants of the preferences and attitudes that I am eliciting from them, to the extent possible.

In the following steps, participants answer a three-question financial literacy quiz (from Lusardi & Mitchell, 2014), and a five-question cognitive reflection test (CRT) using adapted questions from Frederick (2005) and Thomson and Oppenheimer (2016). They receive additional compensation for each block (financial literacy and CRT) if they answer all questions correctly (without the opportunity for a second attempt). For the analysis, the sum of correct answers on both blocks is used and defined as *knowledge score*.

The last decision that the participants make is the time to receive their variable compensation. They can choose to receive it immediately or in 1-4 months with 5% interest per month added to their compensation. The fixed show-up fee is paid separately. The number of months chosen for the compensation delay is defined as *patience*.

Finally, participants navigate to a screen that shows a summary of all their incentivized tasks, the realization of the random choice of the pension decision round for compensation, and the conversion of points of their total compensation into Swiss Francs.

2.6 Participants and Incentives

Participants were recruited online, in 2022, from the Swiss panel (German-speaking subjects only) of the commercial market research vendor Bilendi. The panel is a heterogeneous sample of the adult (18-70) population of Switzerland, instead of the most common samples in the longevity beliefs literature that only include older individuals. Bilendi sent e-mail invitations with a brief description of the experiment and compensation. It also handled all payments to participants afterwards, comprising a fixed show-up fee and any variable incentive. The experiment was implemented on oTree (Chen, Schonger, & Wickens, 2016).

PLACEHOLDER – **TABLE 2**

A total of 2370 participants clicked on invitation links and consented to participate.[20] Among them, 221 violated the monotonicity of survival beliefs and were dropped. Another 362 were dropped after failing the instruction quiz.[21] In total, 1,475 participants made a decision in the first round on the pension choice task.[22] Some descriptive statistics of the characteristics and decisions of the participants (other than survival beliefs and pension choice) for this group are shown in Table 2. Of these participants, 155 voluntarily quit or abandoned the experiment (with non-completions concentrated in the *Reverse* treatment condition), and 1340 completed all tasks and earned compensation.

After data collection ended, eight participants were excluded from the sample for reporting gender other than male or female, because life tables are not available for non-binary genders. Another 12 participants were removed for assigning, for any set of survival beliefs, the same survival probabilities for all target ages.

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[20] The participants were equally split across the fourt treatment conditions at the start of the experiment. Data collection was carried out in several short periods that attracted many simultaneous connections, which, together with the very high number of queries required by our interface design, made it technically unfeasible to dynamically rebalance treatment cells based on participant responses.

[21] Participants were alerted at the welcome and consent screen to the exclusion conditions, which meant they would also not receive any compensation (fixed or variable). The quiz, as implemented, also serves as an attention check.

[22] This extended sample is used in some estimations, where noted.

Treatment cells are reasonably balanced in most characteristics. Differences in CRRA coefficients between treatment conditions could be related to wealth-dependent behavior arising from the possible realization of payoffs from the pension decision rounds. Overall, there is a slight skew towards female participants. The happiness and age measures are very similar in all treatment conditions. The variable incentive compensation earned in the experiment ranged from zero to CHF 58.14, with a median of CHF 7.92. The median completion time for the entire session was 19.3 minutes.

3 Results

3.1 Longevity Biases

A first examination of the average cumulative subjective survival probabilities at all target ages, summarized in Table 3, shows the usual pattern of overestimation (underestimation) of mortality (survival) at earlier target ages, and vice versa at old target ages,[23] (in line with Wu, Stevens, & Thorp, 2015; Heimer, Myrseth, & Schoenle, 2019) for beliefs about oneself. Women underestimate their own survival up to the target age 90 and men up to age 80.

Absolute deviations between actual and subjective probabilities are high at typical ages of the first decade of retirement: women assess an average probability of survival up to age 75 of only 76.9%, while the actual probability (from the life table) is 87.5%. At very old target ages, the overestimation of longevity is also large: men assess their probability of living up to age 95 to be 25.1%, while the actual probability is 9.4%.

PLACEHOLDER – **TABLE 3**

Interestingly, there is also a pervasive bias in survival beliefs about an average person of the same age and gender. For most target ages, the survival beliefs for the average person are closer to the beliefs about oneself than to the actuarial neutral probabilities from the Swiss life table.

The survival beliefs about an average person do not incorporate private longevity information

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[23] The smaller number of observations for target ages younger than 50 are due to the presence in the sample of subjects with ages between 50-70, whose beliefs are only elicit at a smaller set of target ages.

nor relative pessimistic attitudes a subject might hold about risks concerning only him or herself. This suggests the possibility that individuals might be misinformed about human longevity in general. Misinformation, in this context, does not necessarily mean a lack of factual knowledge about human longevity. It could as well arise from cognitive editing processes on risk assessment, such as probability weighting (Prelec, 1998).

PLACEHOLDER – **FIGURE 3**

Figure 3 shows the averages of the (subjective) survival probabilities in the upper graphs. In the lower graphs, the plots are for the average survival biases for oneself, average person and family $\left(q^{j}_{i,t}\right)$, and longevity pessimism $\left(\psi_{i,t}\right)$, across target ages. Higher values indicate more pessimistic beliefs, and zero indicates neutral (not pessimistic or optimistic) beliefs. Cumulative[24] longevity pessimism is present for both genders, but a lower level is present for males in all target ages. Survival bias decreases on target ages for all sets of beliefs of both genders.

Noticeably, women are more pessimistic about their own survival than they think their family and relatives are, at all target ages. Men, on the other hand, are on average consistently more optimistic about themselves than for survival an average Swiss man of their age. Men become optimistic about their own survival $\left(q^{own}_{i,t} < 0\right)$ after target age 70, whereas women become neutral only at target age 95.

PLACEHOLDER – **FIGURE 4**

Of particular interest is the comparison of survival beliefs between oneself and the average person. They reflect subjects' relative assessment of their longevity, compared to peers of same age and gender that do not share the subject's own idiosyncratic longevity risk factors – such as medical diagnosis or family history –, while sharing cohort longevity risks. In Figure 4, each dot represents a pair of one subject's survival beliefs for oneself and for an average person, at different target ages. From their joint distribution, probabilities coalesce at their extremes for both the highest and the lowest target ages. There is more dispersion and outliers at later target ages.

The dispersion of beliefs is at its highest for target ages 80 to 90, which is also the age range where

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[24] Accumulated since the subject's current age, not only at a specific target age as in the upper graphs

the senescence effect (the marginal increase on one-year mortality risk) is particularly important for remaining life expectancy. From the density mass of the joint distribution plots, subjects convey a basic understanding of the 'very high' and 'very low' survival probabilities at both tails of the target age sets $\mathbf{F}_i$. There is much more dispersion in target ages that represents the transition between low mortality risk in middle age and high mortality risk in advanced old age. Hence, the covariance of survival beliefs about oneself and average person is higher when survival probabilities are moderate.

Proceeding further, I examine the factors that drive longevity pessimism and survival bias measures, regressing them on subject characteristics. Results are displayed in Table 4; Higher values for all dependent variables indicate more pessimistic subjects. Happiness is negatively and significantly associated with longevity and survival pessimism: happier subjects are less pessimistic and biased about their longevity, except for the relative comparison between beliefs about oneself and from family and friends about oneself. The effect size is moderate. As pessimism $\psi_{i,t=105}$ is a logarithmic transformation of ratios, each additional unit of the happiness and satisfaction index is associated with 2.42% less distortion of weighted-average mortality probabilities, as aggregated up to target age 105.

PLACEHOLDER – **TABLE 4**

Recent *change in health* is also negatively associated with longevity pessimism and with smaller survival biases measured against actuarial unbiased probabilities. Subjects whose health has improved more within the last year have less negatively distorted assessments of probabilities of oneself, average person and family and friends. Although a change in personal health is a significant (and trivial) driver of actuarial or subjective survival in general (Heimer, Myrseth, & Schoenle, 2019), the results suggest that it also affects the subjects' perceptions of longevity of an average person. This could not be explained by any incorporation of private longevity information that is only relevant for the subjects' own survival.

Otherwise, apart from the stylized gender difference in longevity pessimism (women are more pessimistic than men) firmly established in the literature, no other individual characteristic significantly and consistently affects longevity pessimism and survival bias.

3.2 Pension Decisions

In the main task, subjects decide in which period they want to collect (*Lump-sum* treatment condition), start collecting (*Fair* and *Pessimistic*) or start paying (*Reverse*) pension benefits. Figure 5 shows the distribution of the average (in all rounds) of the pension choice for benefits payoff per subject, per treatment.

PLACEHOLDER – **FIGURE 5**

In the first round, subjects made an average pension choice for payoff at 8.71 periods in *Fair*, 8.37 in *Pessimistic*, 10.02 in *Lump-sum* and 6.37 in *Reverse*. The dispersion of choices is very similar across all conditions, with a standard deviation of choice ranging from 4.37 to 4.67. Taking into account the average of all rounds, subjects chose pension payoffs on average at period 7.95 (*Fair*), 7.36 (*Pessimistic*), 9.53 (*Lump-sum*) and 7.84 (*Reverse*). The general results for the *Fair* and *Lump-sum* decisions are similar to those of Fatas, Lacomba, and Lagos (2007) and reproduced by Bachmann et al. (2022), which used the difference between these two conditions as their main treatment effect.

Fewer subjects chose early *Lump-sum* payouts, compared to the fraction of subjects who chose to start receiving annuity payments earlier in *Fair* and *Pessimistic*. The expected value of the payoffs of the latter is higher than for the other treatments in earlier periods, as discussed in Subsection 2.3, yet a cursory inspection of the pension choice distribution does not show an obvious right-skew that the favorable distortion of present values in earlier periods should attract from risk-neutral or risk-averse subjects.

As discussed in Subsection 2.6, the cases of subjects who quit the experiment after the beginning of the pension decision task were concentrated on *Reverse* treatment. Therefore, results of this treatment should be interpreted with some caution on the possibility of an endogenous treatment effect on subjects who quit the experiment. Notwithstanding, a larger fraction of subjects in this condition chose to start making payments earlier (out of their endowment, specific to this condition) than subjects chose to (start) earning payoffs in other conditions. This could indicate a preference to avoid bankruptcy risks associated with a delay in start of payments (out of the subject endowment) to intermediate periods with moderate survival probabilities.

A particular concern with the pension choice task is that it allows risk-seeking participants to gamble for very high payoffs (upwards of CHF 150 when converted to monetary compensation under three of the conditions) with low probability (5%) by choosing the last period (20) in all rounds. There are 19 such extreme cases (out 1475 observations in the extended sample) of subjects with pension choice at period 20 in all rounds: 5 in *Fair*, 5 in *Lump-sum* and 9 in *Reverse*. At the opposite extreme, 33 subjects always made the pension choice for the first period in all rounds.

Otherwise, the pension choice is somehow sticky: 1102 subjects made identical decisions in all three rounds. Excluding those cases, 146 subjects repeated their decision for the first and second rounds only, and 220 for the second and third rounds only.

PLACEHOLDER – **TABLE 5**

The effects of longevity pessimism on these pension decisions are summarized in Table 5. Pessimism at target age 80 $(\psi_{i,t=80})$ is only weakly associated with pension choice. Since the variable is a logarithmic of ratios and increasing values indicate increasing pessimism, each additional unit of pessimism reduces, on average, the choice payoff period by 0.52 and 0.48 periods in specifications (1) and (2), respectively.

This effect is not significant in (3), when I introduce *change in health* as a control. There, each unit of recent positive change in health (on a scale 0-10) delays the pension choice by 0.19 periods. Change in health is also relevant in additional specifications that include more subject covariates (4) or restrict the sample to decisions in the first round (6).

Treatment effects are significant for the condition *Lump-sum* on the *Fair* baseline in all specifications, associated with a delay in pension choice of 1.35 to 1.56 periods. Adding additional controls for subject characteristics and preferences does not substantially change the coefficient of the treatment indicator. Meanwhile, the treatment effect for *Reverse* is sizeable and significant only for the decisions in the first round. Finally, *Pessimistic* treatment effects are small and weakly significant only, regardless of the additional control variables added to the main specification in (2-4).

All interactions of *treatment* indicators and longevity pessimism are not significant in all specifications. This shows that to the limited extent that pessimism about longevity in general affects experimental pension choice decisions, this does not occur at significantly different margins for any of the treatments compared to the baseline *Fair*.

Some additional personal characteristics and preferences impact pension choice on their own. *Age* has a highly significant but small effect, delaying the pension choice by 0.02 period for each additional year of chronological age in several specifications. *Patience* concerning delay of monetary compensation is positively associated with a later pension choice of payoffs.

The less risk-averse subjects are, as measured by the *CRRA* coefficient[25] from the "bomb" risk elicitation task (Crosetto & Filippin, 2013), the more they delay pension choice as well. Since this risk-aversion elicitation task is presented to participants after the main pension choice task, its results could still be affected by the realization of termination periods over its tree rounds, even if participants will only be informed on which round will be used for monetary compensation at the end of the experiment.

PLACEHOLDER – **TABLE 6**

The findings remain qualitatively unchanged when using several cumulative survival bias measures, instead of the modeled *longevity pessimism*. In Table 6, survival bias for beliefs about oneself with respect to actual probabilities (1,2) and the belief of family and friends about oneself (5,6) are significant drivers of pension choice.

The more pessimistic the subject in those two measures is (the higher $q^{j}_{i,t=80}$), the earlier their pension payoff choice is. The bias implicit in the subject's survival probabilities with respect to those about an average person is not significant for the pension decision in specifications (3,4).

Similarly to the main results, the treatment effects for *Lump-sum* are strong and significant for all bias measures, the treatment effects for *Pessimistic* are limited and weakly significant, and none of the treatment interactions and the three survival biases are significant.

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[25] The higher the coefficient of a classic CRRA power utility function, the less risk-averse the subject is.

3.3 Happiness Indirect Effects on Pension Decision

Happiness and satisfaction can affect longevity pessimism itself, while also having a direct impact on pension choice. Changes in health can also influence longevity pessimism, directly through changes in subjective survival beliefs that, in this case, are related to the subject receiving new private information that directly affects their longevity (Hurd & McGarry, 2002; Kvaerner, 2022).

I attempt to unravel these direct and indirect effects.[26] The three-way relationship between longevity pessimism, change in health and happiness and satisfaction is plotted in Figure 6. The heat map splits all individual observations at the subject level into many bins, according to their joint distribution of happiness and satisfaction and longevity pessimism. The area of the circles is the number of observations in each bin, and its color is the average change in health within that bin. The dashed red lines divide the plot into four quadrants, whose subjects I characterize as sad and pessimist (top left), happy and pessimist (top right), happy and optimist (bottom right), and sad and optimist (bottom left).[27]

PLACEHOLDER – **FIGURE 6**

The relationship between change in health and happiness is clear as it is trivial: people who had more negative changes in recent health also have a lower happiness and satisfaction index, reflecting the negative impact of receiving bad medical news or perceiving a deterioration of one's own health.

In Apicella and De Giorgi (2022), bad health news leads to changes in sentiment that affect subjective longevity beliefs and actual survival probabilities. In this study, the relationship is less clear with respect to the effect of change in health on longevity pessimism. Some of the bins with highest average change of health – implying an improvement on the subject's health status – are in the quadrant 'happy and pessimist'. Also, most of the bins 'happy and optimist' have higher (positive) changes in health. Bins with the lowest reported change in health are weakly skewed towards the 'sad and pessimist' quadrant.

Given these broad distribution patterns – which seem to indicate nonlinearity of the relationship of

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[26] In the pre-registration of this study, a full moderated-mediation model was proposed. However, considering effect size of longevity beliefs on pension decisions, any expected indirect effect is also limited ex ante.

[27] Higher values on *longevity pessimism* indicate more pessimistic subjects.

these three variables – and the presence of categorical concomitants, a simple decomposition of effects of happiness or change in health could be biased. To address this concern, I use a linearized form of the KHB-decomposition (Breen, Karlson, & Holm, 2013, 2021) to identify these indirect effects. Table 7 summarizes its results. For this analysis, the observations are at the subject×target age level.

PLACEHOLDER – **TABLE 7**

For each of the key variables, *reduced* is the coefficient of this variable with respect to *pension choice* when *pessimism* is not included as a regressor, *full* is the coefficient when *pension choice* is included, and *indirect effect* is the difference between the coefficients and its significance, indicating the how much of the effect of variables on pension choice is absorbed and confounded through the effects of longevity pessimism on pension choice.

Indirect effects through longevity pessimism are relevant for all specifications and variables. In specification (1), longevity pessimism confounds 52.1% of the effect of happiness and satisfaction on pension choice, 4.0% of the effect of change in health, and 12.4% of the effect of the gender indicator.

The results should still be taken with the caveat that the coefficients of change in health and happiness are, in general, relatively small and that both variables are partially correlated $\left(\rho = 0.329\right)$ through a plausibly casual relationship. For this reason, I also investigate the decomposition of the effects of both variables separately from each other. In specification (2), longevity pessimism confounds 23.0% of the effect of happiness and satisfaction on pension decision. In specification (3), longevity pessimism confounds 6.45% of the effect of change in health on pension decision.

Overall, the results suggest a complex structural relationship in which longevity pessimism confounds a larger fraction of the effect of change in health and happiness on pension choice, when both casual factors are simultaneously considered.

4 Robustness Checks and Alternative Analysis

4.1 Deviations of Realized Longevity

The sets of survival beliefs j allow the calculation of the partial life expectancy, that is, the number of years expected to live within the time period from age to target age, according to equation (10). Comparing the differences in partial life expectancy in time (years), up to the target age of 105 years, allows an alternative investigation of the factors that drive longevity and survival biases.

Table 8 shows the results of a regression of expected life expectancy on subject characteristics. In this setting, the dependent variables are simple differences, in years, between the partial life expectancy and a benchmark.

PLACEHOLDER – **TABLE 8**

The results are similar to those of the main models, which use longevity pessimism and survival biases (see Table 4). More happiness is significantly associated with longer partial life expectancy in all measures. In specification (1) each additional unit of the happiness and satisfaction index increases one own's partial life expectancy, relative to actuarial expectations form the life table up to age 105, by 1.04 years. This effect is smaller (0.41 additional years per unit of the index) when the benchmark is of the expected realized longevity of an average person of the same age and gender as the subject (specification 4).

The significance (or lack thereof) of other personal characteristics is similar to those of the main analyses using the pessimism and bias measures.

4.2 Pessimism, Longevity Bias and Savings Behavior in the Field

I examine whether longevity pessimism or survival belief biases affect some decisions that subjects make in the field. In particular, I look at the impact of those measures on participation in a tax-incentivized 'third-pillar' individual retirement savings scheme that exists in Switzerland.[28]

The scheme offers, up to a cap, labor income tax deductions for deposits into long-term savings

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[28] so-called *pillar 3a accounts*

managed accounts, which can then be invested into vetted eligible products and securities. Upon retirement, the balances are withdrawn within ten years and taxed, in part, at half-rate[29] as usual income. The balance can also be used to purchase a family residence or (within conditions) as seed capital for a new business.

I evaluate two outcomes: whether the subject has an active third-pillar account (regardless of when it was opened) and, conditional on a positive answer, whether a new deposit in this account was made within the last 12 months.

PLACEHOLDER – **TABLE 9**

In the logistic regressions shown in Table 9, longevity pessimism and survival biases do not affect the odds of a subject owning or making a deposit into a third-pillar retirement account. *Income* is positively associated with participation in the scheme, which is expected because higher effective personal income tax rates make participation in the program more attractive to individuals. *Financial training* increase the odds of a subjective owning an account, which might be reflected in better knowledge of the taxation and/or pension system. *Patience* is positively associated with ownership of a third-pillar account, but not with recent deposits in the accounts.

Happiness and satisfaction affect participation in the savings scheme, while a positive change in health reduces the odds of ownership of an account while having no influence on the offs of a recent deposit. The latter result is, to some extent, puzzling: a recent change in health could affect recent deposit more than the status on whether a subject opened an account possibly many years earlier.

4.3 Survival and Pension Decisions – Additional Controls

In the discussion of the main results (Subsection 3.2), I presented results of the effect of survival bias measures on pension decision.

PLACEHOLDER – **TABLE 10**

In Table 10, I show additional regressions that expand those models, adding more demographic

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[29] There are substantial cantonal differences in the relative net tax incentives embedded in the scheme.

controls.

The results are qualitatively unchanged with respect to the effects of the main variables of interest – the survival bias measures and treatment effects –. The additional variables on demographic characteristics and preferences follow mainly the patterns observed with respect to models using longevity pessimism instead of survival bias (Table 5).

Change in health is positively associated with a delay in pension choice of payoff period. Subjects who are less risk-averse (higher *CRRA* score) delay their pension choice. Higher patience in receiving monetary compensation is also associated with delayed pension choice. *Financial training* and *knowledge score* are not relevant casual factors driving pension choice.

4.4 Determinants of Happiness and Satisfaction

The *happiness and satisfaction* index itself is a factor of a principal components analysis on other measures or overall happiness and satisfaction with present life, life history, finances, and health. The index itself captures 70.9% of the variance of its components.

PLACEHOLDER – **TABLE 11**

In Table 11, I examine how the relationship of this index with other personal characteristics. Change in health has a positive and significant effect on the happiness and satisfaction index. Age has a significant but small effect. Income and education have sizable and significant positive effects on happiness and satisfaction.

5 Discussion and Conclusion

In line with previous studies using samples from older adults, I also find that individuals, on average, underestimate their survival probabilities in relation to actuarial probabilities from life tables. Survival belief biases could arise from different sources. Individuals might be misinformed about longevity, in the sense that they lack the knowledge of proper human survival probabilities at different ages. A typical actuarial survival curve – skewed inverse S-shaped – presents especial cognitive challenges for individuals intuitively integrating its probability mass function. The marginal decrease in the one-year survival probability as a person ages (senescence) can impact the formation of subjective beliefs (Elder, 2013). General attitudes toward risky prospects, in particular probability weighting (Prelec, 1998; Tversky & Kahneman, 1992), could also play a role in how individuals make retirement financial decisions under stochastic survival risk.

Previous studies have shown, for example, that subjects *react* to longevity-impacting events both in terms of reported subjective probabilities (Hurd & McGarry, 2002; Apicella & De Giorgi, 2022) or observed financial behavior in administrative data (Kvaerner, 2022). Usually, such longevity shock-event models will allow for an idiosyncratic term that captures baseline survival over- or underestimation at the individual level. In the exploratory part of this study, the results suggest that longevity misinformation represents a substantial component of this idiosyncratic deviation between subjective and actual probabilities. This partially contradicts the conclusion of Post and Hanewald (2013) about how much of the dispersion of subjective longevity is not explained by awareness of individual longevity risk factors.

The results show that, in fact, subjects not only underestimate their own survival probabilities with respect to life tables (survival belief bias), but also severely underestimate the survival of an average person of their same age and gender (longevity misinformation). Subtle in principle, the distinction of the elicitation object (one's own probabilities or those of an average person) is important. Biases on survival beliefs about oneself can originate from private information on longevity risk factors, such as health status, risky behavior, or family history. However, one's beliefs about survival of an average person of a large population should not be impacted by any long-term risk factor or short-term shocks affecting one's own longevity. Also, any pessimism that is intrinsic to how one assesses his or her own longevity risk, relative to others, should still not affect his/her beliefs about longevity of an average person.

I show evidence of longevity pessimism, accumulated over the lifetime, is high at target ages typical of the first decade of retirement in contemporary societies, when retirees are mostly healthy and when year-on-year mortality probabilities are low (if non-negligible and increasing on age in the senescence dynamic).

To investigate the potential casual impact of longevity pessimism on financial decisions, I deploy a simulated task where subjects make a choice in terms of their pension benefit payoff. This pension choice task offers identical (except in one treatment condition) expected value payoffs in a stochastic survival environment. Its between-subject treatment concerns the pension payoff structure (*Fair* annuity, *Pessimistic* annuity, *Reverse* annuity or *Lump-sum*), and the decision on the timing (and thus survival risk) of payoffs as the outcome, instead of varying the payoff structure within-subjects over multiple rounds.

Because the experimental survival risk is resolved within a very short time, actual survival beliefs, even from a strict bounded-rationality perspective, should not have any impact on how subjects assess their stochastic termination risks in the experimental task. Yet, I find that longevity pessimism, to some extent, affects how much payoff risk subjects undertake. Recent health changes for subjects also affect their pension payoff choices, with those reporting recent health improvement delaying their chosen payoff period, i.e., shifting it to a more risky option. These results further suggest that private longevity information cannot account for the full deviation of reported subjective beliefs from actual unbiased probabilities, which could facilitate the contextualization of results of the previously cited contemporary studies that use shocks to longevity risk factors as an identification mechanism.

Finally, I explore whether longevity pessimism could be a mediator of the effects of happiness and satisfaction (which itself is influenced by recent health changes) on pension choice. Happiness and satisfaction do have significant – if moderate in size – indirect effects on pension choice through longevity beliefs. The presence of indirect effects suggests that the non-misinformation component of longevity pessimism could be related to general predispositions of the subject with respect to risk assessment in a broader sense (not only in the financial risk-taking domain).

In terms of the potential to improve financial decision making in the field, given these findings, longevity misinformation is a better candidate than longevity pessimism for financial literacy interventions (Behrman et al., 2012). Ex ante, the effects of wrong information on longevity could be mitigated with the provision of correct actionable information at the time of decision-making. This would be facilitated, in the field, by the fact that individuals make actual pension decisions infrequently (such as when choosing whether to withdraw lifetime pension savings as lump sum or convert them into annuities). Mitigation of possible longevity pessimism is more challenging:

it concerns how people assess a very specific form of idiosyncratic risk (one's own longevity), for which misperceptions of actual risk factors might contribute (Heimer, Myrseth, & Schoenle, 2019).

These findings have implications for policymakers that consider implementing pension reforms that are, in principle, actuarially-neutral (as in Fatas, Lacomba, & Lagos, 2007). Actuarial neturality within changes to pension decision architecture drives policy expectations that subjects would react according to conditional survival probabilities of life tables, adjusting their decisions accordingly. However, my results corroborate concerns that biased subjective beliefs could produce biased decisions with important consequences for the long-term financial well-being of individuals during retirement.

Overall, I conclude that misinformation about human longevity is an important component of individual survival belief bias. In turn, longevity pessimism affects subjects' pension choice, driving them to make earlier and less risky pension payoff choices. There is also an indirect effect of happiness and satisfaction on these pension choices through its impact on longevity pessimism.

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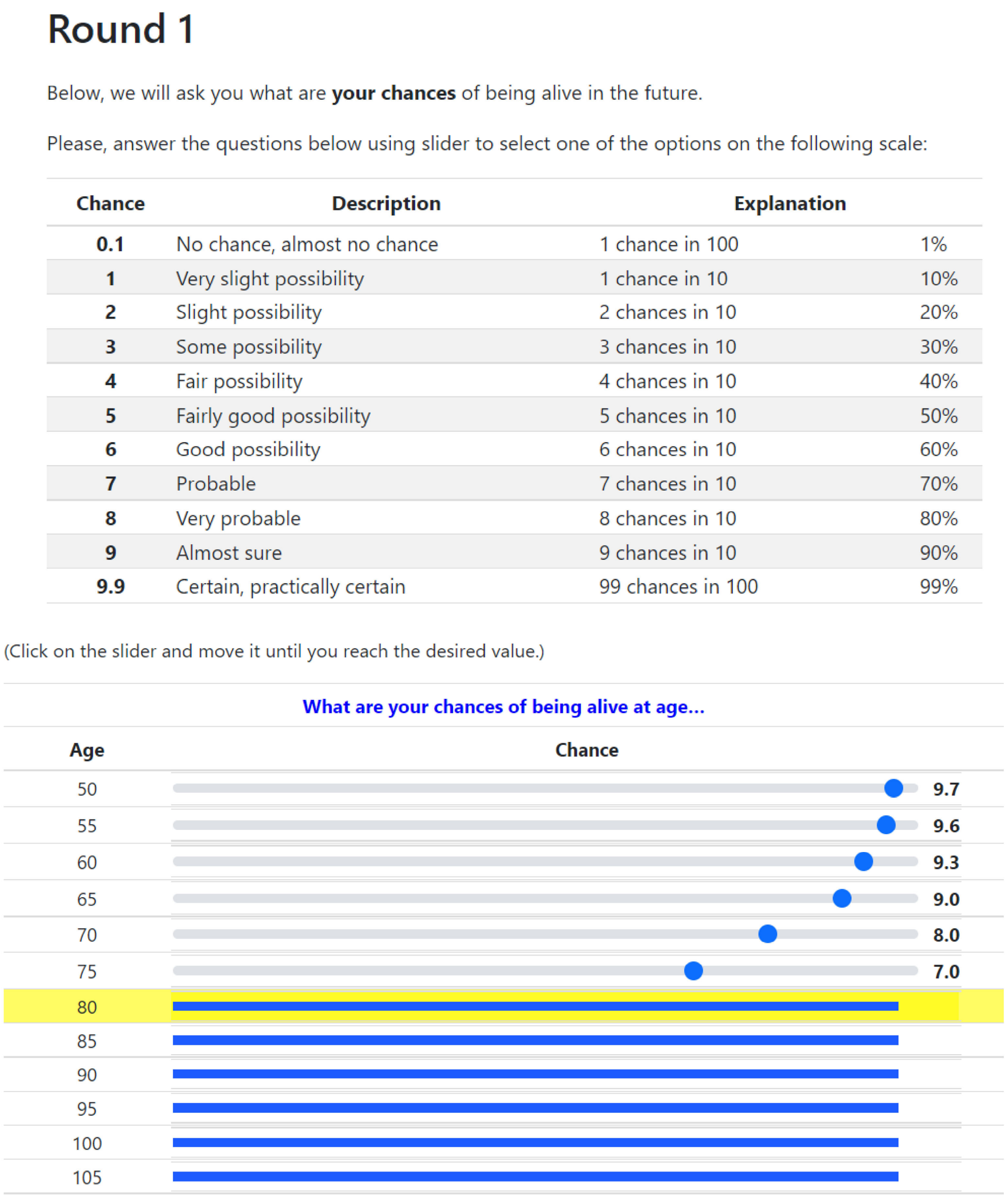
Table 1 – Pension Decision Task Parameters. The table summarizes the experimental parameters for the four treatment conditions. *Cumulative survival* is the probability that a subject survives until the period. *Termination* is the probability that the experimental life ends at the period, conditional on surviving until the period. *Biometric returns* are the compound implicit one-period biometric returns from the start of the round to the period. In the *Fair* and *Pessimistic* treatment conditions, payoffs are the fixed amount of points subjects get, per period, starting at the chosen period, until termination. In *Lump-sum*, subjects get a single payoff in the chosen period. In *Reverse*, subjects receive an endowment of 2000 points at the start of a round and pay the specific amount from the chosen period until termination.

Period	Probabilities		Biometric ret.	Payoffs (points)			
	cml. survival	termination		Fair	Pessimistic	Lump-sum	Reverse
1	1.000	0.050	0.00 %	95	117	1 000	-95
2	0.950	0.053	2.60 %	105	132	1 053	-105
3	0.900	0.056	3.57 %	117	146	1 111	-117
4	0.850	0.059	4.15 %	131	161	1 176	-131
5	0.800	0.063	4.56 %	147	178	1 250	-147
6	0.750	0.067	4.91 %	167	197	1 333	-167
7	0.700	0.071	5.23 %	190	219	1 429	-190
8	0.650	0.077	5.53 %	220	245	1 538	-220
9	0.600	0.083	5.84 %	256	275	1 667	-256
10	0.550	0.091	6.16 %	303	311	1 818	-303
11	0.500	0.100	6.50 %	364	356	2 000	-364
12	0.450	0.111	6.88 %	444	411	2 222	-444
13	0.400	0.125	7.30 %	556	483	2 500	-556
14	0.350	0.143	7.79 %	714	578	2 857	-714
15	0.300	0.167	8.36 %	952	710	3 333	-952
16	0.250	0.200	9.05 %	1 333	903	4 000	-1 333
17	0.200	0.250	9.93 %	2 000	1 207	5 000	-2 000
18	0.150	0.333	11.12 %	3 333	1 746	6 667	-3 333
19	0.100	0.500	12.88 %	6 667	2 909	10 000	-6 667
20	0.050	1.000	16.16 %	20 000	3 377	20 000	-20 000



Round 1

Below, we will ask you what are **your chances** of being alive in the future.

Please, answer the questions below using slider to select one of the options on the following scale:

Chance	Description	Explanation	
0.1	No chance, almost no chance	1 chance in 100	1%
1	Very slight possibility	1 chance in 10	10%
2	Slight possibility	2 chances in 10	20%
3	Some possibility	3 chances in 10	30%
4	Fair possibility	4 chances in 10	40%
5	Fairly good possibility	5 chances in 10	50%
6	Good possibility	6 chances in 10	60%
7	Probable	7 chances in 10	70%
8	Very probable	8 chances in 10	80%
9	Almost sure	9 chances in 10	90%
9.9	Certain, practically certain	99 chances in 100	99%

(Click on the slider and move it until you reach the desired value.)

What are your chances of being alive at age...

Age	Chance
50	**9.7**
55	**9.6**
60	**9.3**
65	**9.0**
70	**8.0**
75	**7.0**
80	
85	
90	
95	
100	
105	

Figure 1 – Interface for elicitation of longevity beliefs. Screenshots of the (translated) online interface used to elicit subjective longevity beliefs. An yellow highlight hovers with the mouse, and subjects determine the starting point the slider for any target age by clicking anywhere on any blue bar.

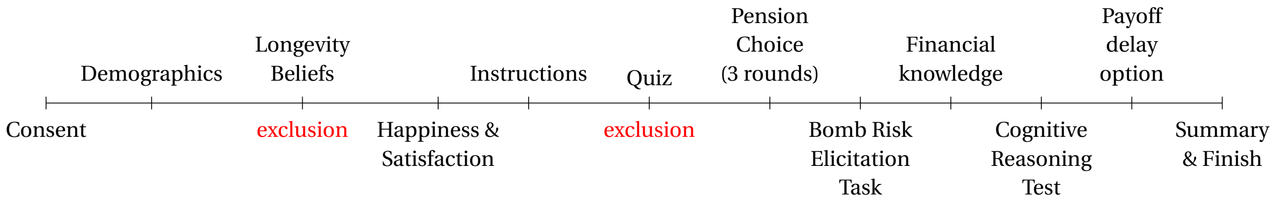


Figure 2 – Timeline of Experimental Session. Subjects are dropped, during the experiment, if they repeatedly violate the monotonicity of elicited cumulative survival beliefs, or fail a simple quiz on the mechanics of the main task.

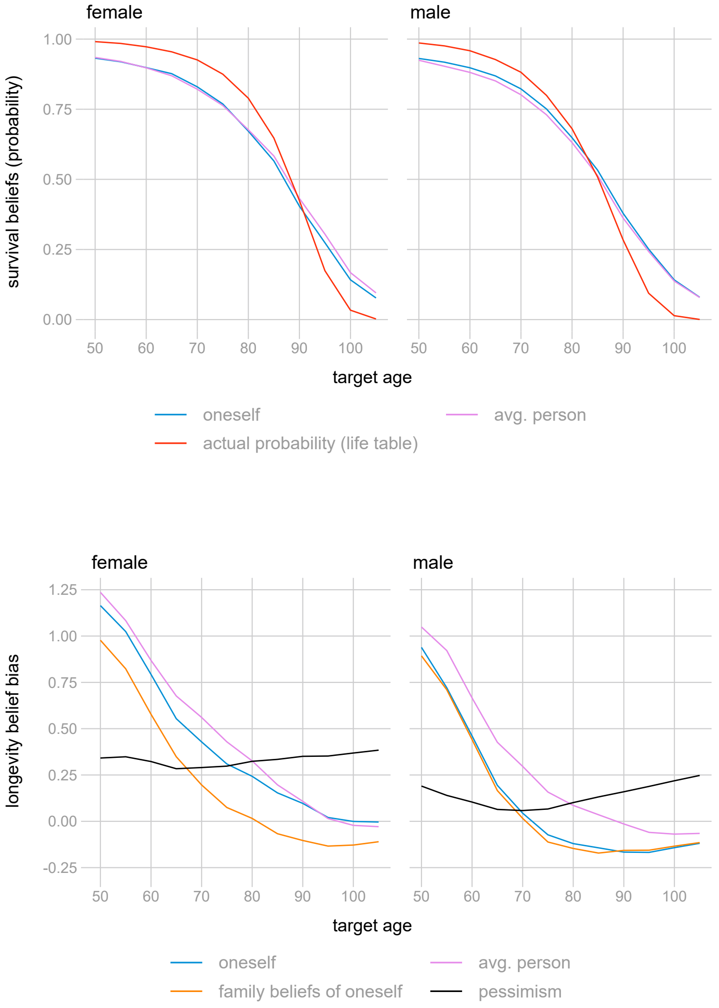


Figure 3 – Bias and Pessimism of Longevity Beliefs. The upper graphs show the sample averages of implicit survival probabilities between *current age* and future *target age* for each subject's belief about oneself and an average Swiss person of the same age and gender. Actual probabilities are from the 2021 Swiss life table. The bottom graphs shows averages for cumulative survival bias $\left(\psi_{i,t}\right)$, for survival beliefs about oneself, about an average Swiss person of same *age* and *gender*, and for one's family and friends' belief about the subject's longevity. Longevity *pessimism* $\left(q^{j}_{i,t}\right)$ is modeled at the individual level for every span between current *age* and *target age* relevant for each subject (the higher the values for the four measures, the more pessimistic a person is, zero implies neutral beliefs).

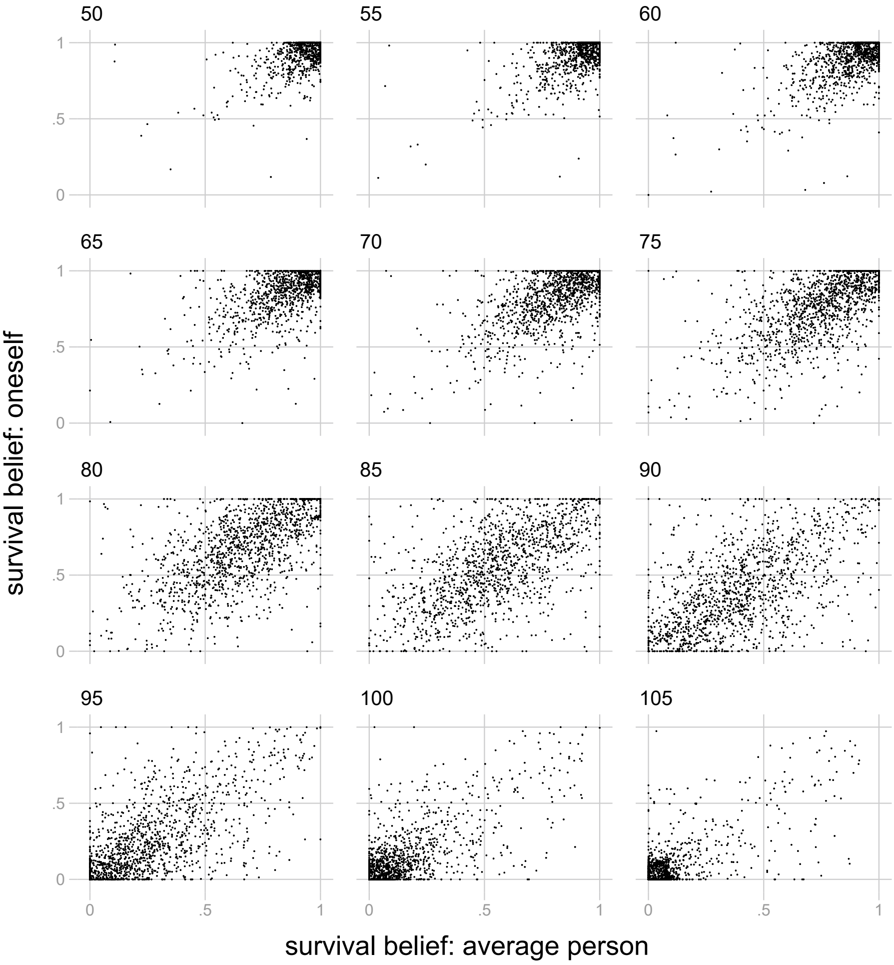


Figure 4 – Survival Beliefs about Oneself and Average Person. For every *target age* plot, each dot is the pair of each subject's reported survival probabilities for oneself and for an average Swiss person of the same current age and gender.

Table 2 – Sample Characteristics. Statistics per treatment condition and for all subjects in the sample. *Patience* is the subject choice (months) to delay compensation (0-4) for 5% monthly interest. *Knowledge score* is sum of correct answers on the CRT (five) and financial literacy (three) questions. *Happiness and satisfaction index* is the first PCA component of five questions on overall happiness and satisfaction. *Change in health, overall happiness* and the four satisfaction variables are measured on a scale of 0-10. Sample with all subjects who finished decisions at least for the first round of the pension choice task.

	Treatment Condition				
	Fair	Pessimistic	Lump-sum	Reverse	(all)
percentage of observations					
gender: male	42.7	49.9	46.7	43.4	45.8
financial training in school: yes	38.0	31.4	32.0	31.4	33.1
has third-pillar account: yes	71.8	69.9	68.5	64.5	68.7
income– < CHF 3000	24.2	20.3	20.1	20.9	21.4
CHF 3000-3999	11.6	11.1	13.3	11.1	11.8
CHF 4000-4999	14.8	18.7	17.6	15.2	16.6
CHF 5000-5999	13.8	15.0	12.4	11.7	13.3
CHF 6000-6999	10.7	10.3	14.9	13.9	12.4
CHF 7000-7999	10.7	8.1	7.7	12.3	9.7
⩾ CHF 8000	14.2	16.4	13.9	14.9	14.9
education– compulsory schooling	2.8	4.9	2.8	3.1	3.5
vocational high school	34.5	38.6	41.7	43.1	39.5
academic high school	16.8	14.0	12.8	14.6	14.5
technical/prof. school	16.5	13.0	13.3	14.6	14.3
university/post-grad.	29.3	29.5	29.4	24.6	28.3
employment– active, full time	52.4	55.8	55.0	48.7	53.1
active, part time	23.9	22.4	22.5	27.7	24.1
outside workforce	5.7	6.9	3.3	5.9	5.5
retired	5.7	6.6	8.9	7.8	7.3
student	10.0	6.9	8.9	7.3	8.2
unemployed	2.3	1.5	1.4	2.5	1.9
mean					
age	41.387	40.430	41.961	41.896	41.386
CRRA	0.847	0.784	0.841	0.708	0.803
patience	2.616	2.331	2.428	2.627	2.480
knowledge score	4.636	4.664	4.715	4.525	4.648
recent (12mo.) change in health	5.646	5.791	5.954	5.964	5.839
happiness and satisfaction index	-0.061	0.081	0.059	0.013	0.025
overall happiness	7.566	7.740	7.667	7.608	7.649
satisfaction with present life	7.504	7.689	7.682	7.669	7.638
satisfaction with life history	7.194	7.367	7.301	7.279	7.288
satisfaction with finances	6.299	6.357	6.358	6.313	6.333
satisfaction with health	7.401	7.412	7.486	7.401	7.425
median					
total incentivized payoff (CHF)	5.99	6.41	8.84	11.40	7.92
completion time (seconds)	1177	1160	1119	1207	1159
N	351	407	360	357	1475

Table 3 – Longevity Beliefs and Biases per Target Age. Longevity beliefs are cumulative survival probabilities between current age and each future target age (rows). *Life table* are actuarial unbiased probabilities from the Swiss life table for 2021. *Oneself* are beliefs of the subject about his/her longevity. *Average person* are beliefs of the subjects about the longevity of an average Swiss person of the same current age and gender. *Family* are subject's expectation of the longevity beliefs of family and friends about the subject. The three $\iota_{i,t}^{j}$ variables measure scaled survival biases for oneself, average person and family, respectively, until each target age. *Pessimism* is the cumulative modeled index of longevity pessimism from the first target age (higher values indicate more pessimism).

	Longevity Beliefs				Survival Bias (scaled)				
target age	life table	oneself	average person	family	$\iota_{i,t}^{own}$	$\iota_{i,t}^{pop}$	$\iota_{i,t}^{fam}$	longevity pessimism	Obs.
female									
50	0.991	0.932	0.935	0.948	8.266	8.033	6.431	0.342	546
55	0.985	0.919	0.921	0.937	5.759	5.473	4.328	0.348	592
60	0.973	0.898	0.898	0.920	3.951	3.836	3.004	0.323	636
65	0.955	0.877	0.869	0.899	2.704	2.899	2.223	0.284	675
70	0.926	0.830	0.822	0.861	2.395	2.473	1.961	0.290	711
75	0.875	0.769	0.763	0.804	1.850	1.885	1.557	0.298	712
80	0.789	0.672	0.677	0.718	1.556	1.531	1.335	0.324	712
85	0.647	0.566	0.583	0.619	1.231	1.180	1.078	0.334	712
90	0.425	0.405	0.432	0.463	1.036	0.987	0.934	0.351	712
95	0.174	0.274	0.305	0.317	0.879	0.842	0.827	0.352	712
100	0.034	0.142	0.168	0.176	0.888	0.861	0.853	0.369	712
105	0.002	0.077	0.095	0.104	0.925	0.907	0.898	0.384	712
male									
50	0.986	0.931	0.925	0.931	5.849	6.463	5.798	0.190	375
55	0.976	0.918	0.903	0.912	3.705	4.607	4.197	0.140	432
60	0.959	0.898	0.882	0.892	2.673	2.958	2.627	0.104	496
65	0.927	0.869	0.851	0.864	1.913	2.060	1.867	0.064	539
70	0.882	0.823	0.802	0.821	1.588	1.759	1.567	0.058	606
75	0.799	0.751	0.730	0.756	1.240	1.336	1.205	0.067	608
80	0.681	0.649	0.631	0.658	1.099	1.151	1.064	0.101	608
85	0.509	0.533	0.514	0.542	0.950	0.989	0.930	0.132	608
90	0.285	0.379	0.362	0.379	0.868	0.891	0.867	0.160	608
95	0.094	0.251	0.243	0.251	0.826	0.836	0.827	0.189	608
100	0.014	0.142	0.138	0.139	0.870	0.874	0.872	0.219	608
105	0.001	0.080	0.079	0.084	0.921	0.922	0.917	0.248	608

Table 4 – Formation of Longevity Belief Biases and Pessimism. OLS regressions of *pessimism* and other survival bias measures. *Employment: k* are indicators that equal one for each category *k* of employment status, and zero otherwise. See Table 5 for the definition of other variables.

	(1)	(2)	(3)	(4)	(5)	(6)
dependent variable:	$\psi_{i,t=105}$	$q^{own}_{i,t=105}$	$q^{own:pop}_{i,t=105}$	$q^{own:fam}_{i,t=105}$	$q^{pop}_{i,t=105}$	$q^{fam}_{i,t=105}$
happiness and satisfaction	-0.0245^{***}	-0.0450^{***}	-0.0278^{***}	0.0030	-0.0173^{**}	-0.0384^{***}
	[0.0051]	[0.0072]	[0.0076]	[0.0094]	[0.0069]	[0.0076]
change in health	-0.0083^{**}	-0.0446^{***}	0.0048	−0.0013	-0.0447^{***}	-0.0407^{***}
	[0.0042]	[0.0084]	[0.0061]	[0.0092]	[0.0082]	[0.0082]
CRRA	0.0073	−0.0201	0.0165	0.0056	−0.0172	−0.0178
	[0.0166]	[0.0126]	[0.0241]	[0.0133]	[0.0109]	[0.0146]
patience	−0.0003	−0.0048	−0.0003	0.0035	−0.0005	−0.0056
	[0.0045]	[0.0072]	[0.0066]	[0.0089]	[0.0070]	[0.0073]
financial training: yes	−0.0070	−0.0134	−0.0095	0.0015	−0.0008	0.0011
	[0.0183]	[0.0293]	[0.0272]	[0.0374]	[0.0282]	[0.0303]
knowledge score	-0.0086^{*}	0.0098	-0.0181^{***}	−0.0013	0.0168^{**}	0.0013
	[0.0047]	[0.0077]	[0.0069]	[0.0104]	[0.0078]	[0.0087]
gender: male	-0.1422^{***}	-0.0974^{***}	-0.0786^{***}	-0.1570^{***}	−0.0328	0.0298
	[0.0170]	[0.0274]	[0.0251]	[0.0342]	[0.0268]	[0.0284]
age	0.0032^{***}	−0.0016	−0.0010	0.0010	−0.0010	-0.0025^{**}
	[0.0008]	[0.0011]	[0.0011]	[0.0016]	[0.0010]	[0.0011]
education	−0.0062	−0.0017	−0.0111	−0.0039	0.0066	−0.0008
	[0.0062]	[0.0112]	[0.0090]	[0.0132]	[0.0108]	[0.0115]
employment: active, part-time	0.0062	0.0080	0.0025	−0.0560	0.0166	0.0526
	[0.0218]	[0.0332]	[0.0327]	[0.0398]	[0.0328]	[0.0336]
employment: outside workforce	−0.0082	0.0331	−0.0173	−0.0205	0.0160	0.0467
	[0.0333]	[0.0543]	[0.0484]	[0.0932]	[0.0509]	[0.0636]
employment: retired	0.0423	0.0750	0.0529	0.0588	0.0168	0.0532
	[0.0398]	[0.0533]	[0.0562]	[0.0876]	[0.0434]	[0.0586]
employment: student	−0.0063	−0.0177	0.0006	0.0680	−0.0258	−0.0852
	[0.0267]	[0.0444]	[0.0415]	[0.0589]	[0.0447]	[0.0521]
employment: unemployed	0.0028	0.0747	−0.0415	0.2427^{**}	0.1239	−0.0076
	[0.0415]	[0.0759]	[0.0691]	[0.1216]	[0.0977]	[0.0918]
constant	0.3547^{***}	0.2949^{***}	0.2217^{***}	0.2530^{**}	0.1784^{**}	0.2279^{**}
	[0.0496]	[0.0897]	[0.0726]	[0.1122]	[0.0847]	[0.0913]
Adjusted R^2	0.106	0.100	0.032	0.012	0.058	0.065
N	1276	1276	1276	1276	1276	1276

Heterokedasticity-robust standard errors in brackets
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 5 – Longevity Pessimism and Pension Choice. OLS regressions of the pension choice (payoff period). In (1-4) the dependent variable is the average of periods chosen on 3 round. In (5,6) it is the pension choice of the first round only. *Longevity pessimism* measured at target age 80 ($\psi_{i,t=80}$) for each subject; higher values indicate more pessimist subjects, zero indicates neutral (unbiased) beliefs. *Pessimistic*, *Lump-sum* and *Reverse* are indicators that equal one for the treatment condition and zero otherwise (*Fair* is the baseline condition). *Gender: male* and *financial training: yes* are indicators that equal one if for the respective categories, and zero otherwise.*Age* measured in years and *education* on as levels 1-5. *Happiness and satisfaction* is an index equal to the first factor a PCA analysis on 5 measures of overall happiness and satisfaction. Recent (1yr.) *change in health* is measured on a scale 0-10. *Knowledge score* is the number of correct answers (0-8) on a financial literacy quiz and CRT, combined. *CRRA* is the risk-aversion coefficent from a power utility model extracted from the “bomb” risk elicitation task (BRET). *Patience* is the delay choice, in months, (0-4) of subject compensation in exchange of interest.

dep. variable: pension choice *rounds:*	(1) all rounds	(2) all rounds	(3) all rounds	(4) all rounds	(5) 1st round	(6) 1st round
longevity pessimism	-0.737^{*}	-0.649^{*}	−0.549	−0.522	-0.900^{**}	−0.706
	[0.383]	[0.384]	[0.381]	[0.385]	[0.431]	[0.432]
treatment: Pessimistic	-0.515^{*}	-0.495^{*}	-0.507^{*}	-0.496^{*}	−0.208	−0.152
	[0.299]	[0.297]	[0.297]	[0.301]	[0.365]	[0.370]
treatment: Lump-sum	1.560^{***}	1.554^{***}	1.497^{***}	1.482^{***}	1.360^{***}	1.354^{***}
	[0.291]	[0.291]	[0.289]	[0.286]	[0.360]	[0.359]
treatment: Reverse	−0.471	−0.460	−0.496	−0.497	-2.368^{***}	-2.374^{***}
	[0.427]	[0.429]	[0.429]	[0.434]	[0.478]	[0.487]
Pessimistic × longevity pessimism	0.252	0.204	0.160	0.219	0.143	0.233
	[0.485]	[0.485]	[0.482]	[0.495]	[0.576]	[0.585]
Lump-sum × longevity pessimism	0.403	0.350	0.336	0.325	−0.032	−0.105
	[0.463]	[0.462]	[0.456]	[0.456]	[0.573]	[0.564]
Reverse × longevity pessimism	0.757	0.708	0.655	0.525	0.705	0.520
	[0.753]	[0.757]	[0.750]	[0.745]	[0.810]	[0.801]
gender: male		0.200	0.188	0.291		0.340
		[0.223]	[0.222]	[0.223]		[0.270]
age		0.021^{***}	0.023^{***}	0.022^{***}		0.022^{**}
		[0.008]	[0.008]	[0.008]		[0.009]
education		0.084	0.098	0.112		0.169
		[0.081]	[0.081]	[0.084]		[0.105]
happiness and satisfaction			−0.024	−0.005		−0.035
			[0.060]	[0.060]		[0.076]
change in health			0.194^{***}	0.175^{***}		0.234^{***}
			[0.059]	[0.059]		[0.071]
financial training: yes				−0.277		−0.166
				[0.229]		[0.277]
knowledge score				-0.110^{*}		−0.122
				[0.063]		[0.079]
CRRA				0.308^{***}		0.249^{***}
				[0.056]		[0.062]
patience				0.150^{***}		0.205^{***}
				[0.057]		[0.071]
constant	8.005^{***}	6.746^{***}	5.521^{***}	5.546^{***}	8.812^{***}	5.673^{***}
	[0.226]	[0.435]	[0.554]	[0.659]	[0.267]	[0.826]
Adjusted R^2	0.050	0.057	0.064	0.082	0.063	0.088
N	1320	1320	1320	1276	1320	1276

Heterokedasticity-robust standard errors in brackets
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 6 – Survival Belief Bias and Pension Choice. OLS regressions of the pension choice (payoff period) on different survival bias measures (accumulated until target age 80) of survival beliefs about oneself: from actual (life table) probabilities (1,2), from average Swiss person of same age and gender (2,3); from the belief of family and friends about the subject's survival (5,6). See Table 5 for the definition of other variables.

dep. variable: pension choice	(1)	(2)	(3)	(4)	(5)	(6)
measure of longev. belief bias:	$q^{own}_{i,t=80}$	$q^{own}_{i,t=80}$	$q^{own:pop}_{i,t=80}$	$q^{own:pop}_{i,t=80}$	$q^{own:fam}_{i,t=80}$	$q^{own:fam}_{i,t=80}$
survival belief bias	-0.396^{**}	-0.324^{*}	-0.267	-0.249	-0.439^{**}	-0.425^{**}
	[0.193]	[0.194]	[0.260]	[0.257]	[0.191]	[0.189]
treatment: Pessimistic	-0.466^{*}	-0.477^{*}	-0.451^{*}	-0.474^{*}	-0.533^{*}	-0.551^{**}
	[0.268]	[0.268]	[0.264]	[0.263]	[0.276]	[0.276]
treatment: Lump-sum	1.581^{***}	1.536^{***}	1.640^{***}	1.577^{***}	1.511^{***}	1.453^{***}
	[0.271]	[0.270]	[0.268]	[0.266]	[0.280]	[0.279]
treatment: Reverse	-0.333	-0.372	-0.283	-0.331	-0.516	-0.576
	[0.392]	[0.394]	[0.384]	[0.385]	[0.393]	[0.391]
Pessimistic × *longevity belief*	0.015	-0.022	0.076	0.071	0.108	0.101
	[0.247]	[0.246]	[0.339]	[0.336]	[0.271]	[0.271]
Lump-sum × *longevity belief*	0.148	0.116	0.231	0.249	0.293	0.283
	[0.240]	[0.239]	[0.308]	[0.304]	[0.253]	[0.250]
Reverse × *longevity belief*	0.286	0.253	0.553	0.549	0.586	0.624
	[0.351]	[0.350]	[0.561]	[0.555]	[0.398]	[0.399]
gender: male	0.201	0.189	0.267	0.240	0.228	0.202
	[0.219]	[0.218]	[0.220]	[0.218]	[0.219]	[0.218]
age	0.018^{**}	0.021^{***}	0.021^{***}	0.022^{***}	0.022^{***}	0.023^{***}
	[0.008]	[0.008]	[0.008]	[0.008]	[0.008]	[0.008]
education	0.090	0.106	0.085	0.096	0.093	0.105
	[0.080]	[0.080]	[0.081]	[0.081]	[0.081]	[0.081]
happiness and satisfaction		-0.043		-0.009		-0.012
		[0.060]		[0.060]		[0.059]
change in health		0.181^{***}		0.201^{***}		0.202^{***}
		[0.059]		[0.059]		[0.058]
constant	6.759^{***}	5.576^{***}	6.582^{***}	5.364^{***}	6.691^{***}	5.457^{***}
	[0.426]	[0.548]	[0.422]	[0.543]	[0.425]	[0.546]
Adjusted R^2	0.061	0.067	0.054	0.063	0.058	0.067
N	1320	1320	1320	1320	1320	1320

Heterokedasticity-robust standard errors in brackets
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 7 – Indirect Effects of Happiness through Longevity Beliefs. The table shows the results of a linearized KHB-decomposition of the direct and indirect effects of *happiness and satisfaction* index, *change in health*, and *gender*, on the average pension choice of payoff period. '*Reduced*' rows the coefficients of a regression excluding the control variable *pessimism*. '*Full*' are the coefficients of a specificiation including the control. '*Indirect Effect*' is the partial effect of the variables on *pension choice* through their own effects on longevity *pessimism*. *Happiness and satisfaction* is an index equal to the first factor a PCA analysis on 5 measures of overall happiness and satisfaction. Recent (1yr.) *change in health* is measured on a scale 0-10. *Gender: male* is an indicator that equals one for male, and zero for female subjects. Concomitant factors (not shown) include *education*, *financial training*, *knowledge score*, *CRRA*, *patience*, *target age* and indicator variables for treatments. See Table 5 for other variables' definition. Observations are subject×target age.

dep. var.: pension choice	(1)	(2)	(3)
happiness and satisfaction			
Reduced	0.028	0.083***	
	[0.017]	[0.016]	
Full	0.013	0.064***	
	[0.017]	[0.017]	
Indirect Effect	0.014***	0.019***	
	[0.004]	[0.005]	
change in health			
Reduced	0.166***		0.174***
	[0.017]		[0.016]
Full	0.159***		0.163***
	[0.017]		[0.016]
Indirect Effect	0.007**		0.011***
	[0.003]		[0.004]
gender: male			
Reduced	0.453***	0.469***	0.455***
	[0.064]	[0.064]	[0.064]
Full	0.397***	0.404***	0.397***
	[0.064]	[0.064]	[0.064]
Indirect Effect	0.056***	0.065***	0.059***
	[0.012]	[0.012]	[0.012]
N	14355	14355	14355

Robust standard errors in brackets

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 8 – Implicit Subjective Life Expectancy. OLS regression of measures of expected realized longevity at age 105, relative to different benchmarks. *Employment: k* are indicators that equal one for each category k of employment status, and zero otherwise. See Table 5 for the definition of other variables.

	(1)	(2)	(3)	(4)	(5)
dependent variable (yrs):	$kex^{own}_{i,t=105}$	$kex^{own:pop}_{i,t=105}$	$kex^{own:fam}_{i,t=105}$	$kex^{pop}_{i,t=105}$	$kex^{fam}_{i,t=105}$
happiness and satisfaction	1.0447^{***}	0.6397^{***}	0.2917^{**}	0.4050^{***}	0.7530^{***}
	[0.1502]	[0.1291]	[0.1376]	[0.1406]	[0.1480]
change in health	0.7464^{***}	0.0812	0.0621	0.6652^{***}	0.6844^{***}
	[0.1386]	[0.1014]	[0.1183]	[0.1318]	[0.1462]
CRRA	0.3398^{*}	0.1002	0.1906	0.2396	0.1492
	[0.2058]	[0.1498]	[0.1417]	[0.1883]	[0.1994]
patience	0.1000	0.0063	0.0445	0.0937	0.0555
	[0.1337]	[0.1039]	[0.1157]	[0.1299]	[0.1335]
financial training: yes	0.4047	0.2203	0.3344	0.1844	0.0703
	[0.5352]	[0.4262]	[0.4683]	[0.5188]	[0.5316]
knowledge score	−0.1678	−0.0244	-0.4051^{***}	−0.1435	0.2373
	[0.1457]	[0.1118]	[0.1262]	[0.1524]	[0.1569]
gender: male	2.6055^{***}	1.3540^{***}	2.6101^{***}	1.2515^{**}	−0.0046
	[0.5285]	[0.4142]	[0.4429]	[0.5272]	[0.5271]
age	0.0607^{***}	−0.0073	−0.0269	0.0681^{***}	0.0876^{***}
	[0.0209]	[0.0158]	[0.0183]	[0.0201]	[0.0205]
education	0.0227	0.1985	0.0212	−0.1758	0.0015
	[0.1993]	[0.1486]	[0.1672]	[0.1916]	[0.2041]
employment: active, full time	0.1702	0.3393	0.8698^{*}	−0.1691	−0.6996
	[0.6266]	[0.4643]	[0.4935]	[0.6208]	[0.6166]
employment: outside workforce	−0.3026	−0.4805	0.9497	0.1779	−1.2522
	[1.1443]	[0.8691]	[0.9500]	[1.0237]	[1.1934]
employment: retired	−1.1400	-1.2894^{**}	−0.1436	0.1494	−0.9964
	[0.9177]	[0.6568]	[0.7104]	[0.7694]	[0.8460]
employment: student	1.0241	−0.4165	−1.4565	1.4406	2.4806^{**}
	[1.1096]	[0.9677]	[1.0922]	[1.0018]	[1.0522]
employment: unemployed	−1.1698	2.3006	−2.1778	−3.4704	1.0080
	[2.2206]	[1.8567]	[2.0914]	[2.7777]	[2.0012]
constant	-9.1023^{***}	−1.4081	−0.2593	-7.6942^{***}	-8.8430^{***}
	[1.7682]	[1.3077]	[1.5885]	[1.6676]	[1.9132]
Adjusted R^2	0.125	0.044	0.034	0.060	0.075
N	1276	1276	1276	1276	1276

Heterokedasticity-robust errors in brackets

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 9 – Longevity Beliefs and Long-Term Saving Schemes. The table reports the odds' ratio of a logistic regression of indicator variables on third-pillar accounts. In (1-3), the dependent variable is one if the subjects owns a third-pillar tax-incentivized retirement savings account. In (4-6), the dependent variable is one if the subject – conditional on having an account – made a qualified deposit within the last year. *Longevity pessimism* measured at target age 80 ($\psi_{i,t=80}$) for each subject; higher values indicate more pessimist subjects, zero indicates neutral (unbiased) beliefs. *Income* is defined in levels 1-8. See Table 5 for the definition of other variables.

	(1)	(2)	(3)	(4)	(5)	(6)
3rd-pillar scheme:	account	account	account	deposit	deposit	deposit
longevity pessimism	0.126			0.082		
	[0.128]			[0.209]		
survival bias $q_{i,t=80}^{own:pop}$		0.053			−0.009	
		[0.086]			[0.139]	
survival bias $q_{i,t=80}^{own}$			0.064			0.130
			[0.068]			[0.106]
gender: male	-0.024	−0.045	−0.031	0.103	0.085	0.110
	[0.155]	[0.153]	[0.154]	[0.252]	[0.251]	[0.250]
age	-0.005	−0.005	−0.004	−0.058***	−0.058***	−0.057***
	[0.006]	[0.005]	[0.006]	[0.010]	[0.010]	[0.010]
education	0.009	0.010	0.007	−0.106	−0.108	−0.106
	[0.062]	[0.062]	[0.062]	[0.101]	[0.101]	[0.101]
happiness and satisfaction	0.128***	0.123***	0.128***	0.175***	0.168***	0.188***
	[0.042]	[0.042]	[0.043]	[0.066]	[0.065]	[0.066]
change in health	-0.085**	−0.087**	−0.082**	−0.082	−0.082	−0.078
	[0.040]	[0.040]	[0.040]	[0.064]	[0.064]	[0.064]
income	0.434***	0.434***	0.432***	0.249***	0.249***	0.248***
	[0.046]	[0.046]	[0.046]	[0.068]	[0.068]	[0.068]
financial training: yes	0.407**	0.404**	0.406**	0.053	0.053	0.048
	[0.162]	[0.162]	[0.162]	[0.246]	[0.245]	[0.247]
knowledge score	0.046	0.047	0.045	−0.015	−0.015	−0.017
	[0.043]	[0.043]	[0.043]	[0.075]	[0.075]	[0.075]
CRRA	0.019	0.018	0.021	0.242*	0.239*	0.257*
	[0.041]	[0.042]	[0.042]	[0.130]	[0.129]	[0.134]
patience	0.115***	0.115***	0.115***	0.015	0.016	0.017
	[0.040]	[0.040]	[0.040]	[0.061]	[0.061]	[0.061]
constant	-0.596	−0.557	−0.609	4.101***	4.119***	4.036***
	[0.465]	[0.464]	[0.465]	[0.806]	[0.799]	[0.805]
N	1124	1124	1124	777	777	777

Heterokedasticity-robust standard errors in brackets

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 10 – Additional Analysis on Alternative Measures of Survival Bias. OLS regressions of pension choice (payoff period) on different survival bias measures (accumulated up to target age 80) of longevity beliefs about oneself: from actual (life table) probabilities (1), from average Swiss person of same age and gender (2); from the belief of family and friends about the subject's longevity (3). See Table 5 for the definition of other variables.

dep. variable: pension choice *measure of longev. belief bias:*	(1) $q^{own}_{i,t=80}$	(2) $q^{own:pop}_{i,t=80}$	(3) $q^{own:fam}_{i,t=80}$
survival belief bias	−0.281	−0.267	-0.401^{**}
	[0.194]	[0.258]	[0.191]
treatment: Pessimistic	-0.454^{*}	-0.447^{*}	-0.535^{*}
	[0.271]	[0.267]	[0.281]
treatment: Lump-sum	1.523^{***}	1.560^{***}	1.441^{***}
	[0.267]	[0.264]	[0.277]
treatment: Reverse	−0.413	−0.367	−0.593
	[0.393]	[0.386]	[0.399]
Pessimistic × *survival belief*	−0.005	0.121	0.128
	[0.250]	[0.345]	[0.277]
Lump-sum × *survival belief*	0.105	0.251	0.245
	[0.237]	[0.304]	[0.250]
Reverse × *survival belief*	0.328	0.381	0.569
	[0.353]	[0.540]	[0.391]
gender: male	0.297	0.339	0.300
	[0.222]	[0.221]	[0.220]
age	0.020^{**}	0.021^{***}	0.022^{***}
	[0.008]	[0.008]	[0.008]
education	0.121	0.107	0.113
	[0.084]	[0.084]	[0.084]
happiness and satisfaction	−0.016	0.007	0.006
	[0.061]	[0.060]	[0.059]
change in health	0.167^{***}	0.182^{***}	0.183^{***}
	[0.059]	[0.059]	[0.058]
financial training: yes	−0.289	−0.265	−0.258
	[0.230]	[0.229]	[0.228]
knowledge score	−0.103	-0.113^{*}	−0.103
	[0.063]	[0.063]	[0.063]
CRRA	0.301^{***}	0.313^{***}	0.311^{***}
	[0.057]	[0.056]	[0.054]
patience	0.151^{***}	0.151^{***}	0.152^{***}
	[0.056]	[0.056]	[0.056]
constant	5.516^{***}	5.417^{***}	5.455^{***}
	[0.650]	[0.645]	[0.646]
Adjusted R^2	0.084	0.081	0.085
Observations	1276	1276	1276

Heterokedasticity-robust errors in brackets
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 11 – Determinants of Happiness and Satisfaction. OLS regressions for *happiness and satisfaction* index (the first PCA factor on 5 measures of overall happiness and satisfaction with present life, life history, health and finances). *Gender: male* and *financial training: yes* are indicators that equal one if for the respective categories, and zero otherwise.*Age* measured in years, *education* as levels 1-5 and *income* as levels 1-8. Recent (1yr.) *change in health* is measured on a scale 0-10. *Knowledge score* is the number of correct answers (0-8) on a financial literacy quiz and CRT, combined. *CRRA* is the risk-aversion coefficient from a power utility model extracted from the "bomb" risk elicitation task (BRET). *Patience* is the delay choice, in months, (0-4) of participant compensation in exchange of interest.

	(1)	(2)	(3)	(4)
change in health	0.307^{***}	0.308^{***}	0.303^{***}	0.299^{***}
	[0.026]	[0.026]	[0.027]	[0.027]
gender: male		−0.159	−0.151	−0.138
		[0.104]	[0.106]	[0.109]
age		0.019^{***}	0.019^{***}	0.020^{***}
		[0.003]	[0.004]	[0.004]
income		0.168^{***}	0.155^{***}	0.152^{***}
		[0.026]	[0.027]	[0.027]
education		0.137^{***}	0.111^{**}	0.113^{***}
		[0.041]	[0.043]	[0.044]
financial training: yes			0.192^{*}	0.196^{*}
			[0.105]	[0.107]
knowledge score			0.015	0.012
			[0.029]	[0.030]
CRRA				−0.019
				[0.033]
patience				0.017
				[0.028]
constant	-1.762^{***}	-3.558^{***}	-3.524^{***}	-3.528^{***}
	[0.173]	[0.263]	[0.305]	[0.315]
R^2	0.106	0.195	0.192	0.187
N	1320	1184	1168	1146

Heterokedasticity-robust standard in brackets

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

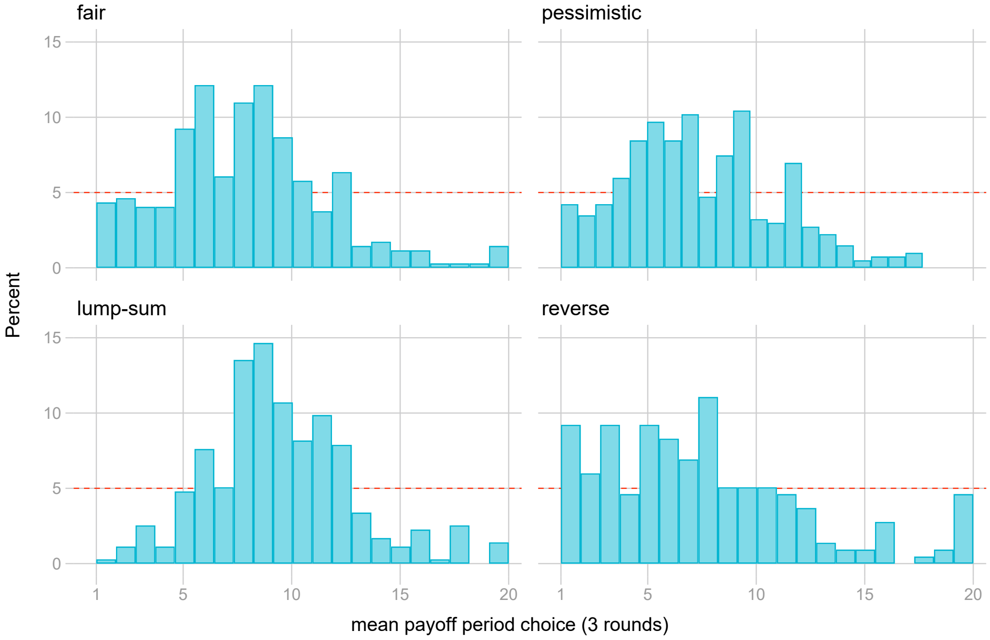


Figure 5 – Pension Choice and Treatments. Graphs show the distribution of mean *pension decision* of payoff period chosen by subjects across three rounds, per treatment condition. On *Fair* and *Pessimistic* conditions, the decision is when to start receiving payoffs. On *Lump-sum*, the decision is on the timing of the single payoff. On *Reverse*, the decision is when to start making payments. Uniform distribution highlighted in red.

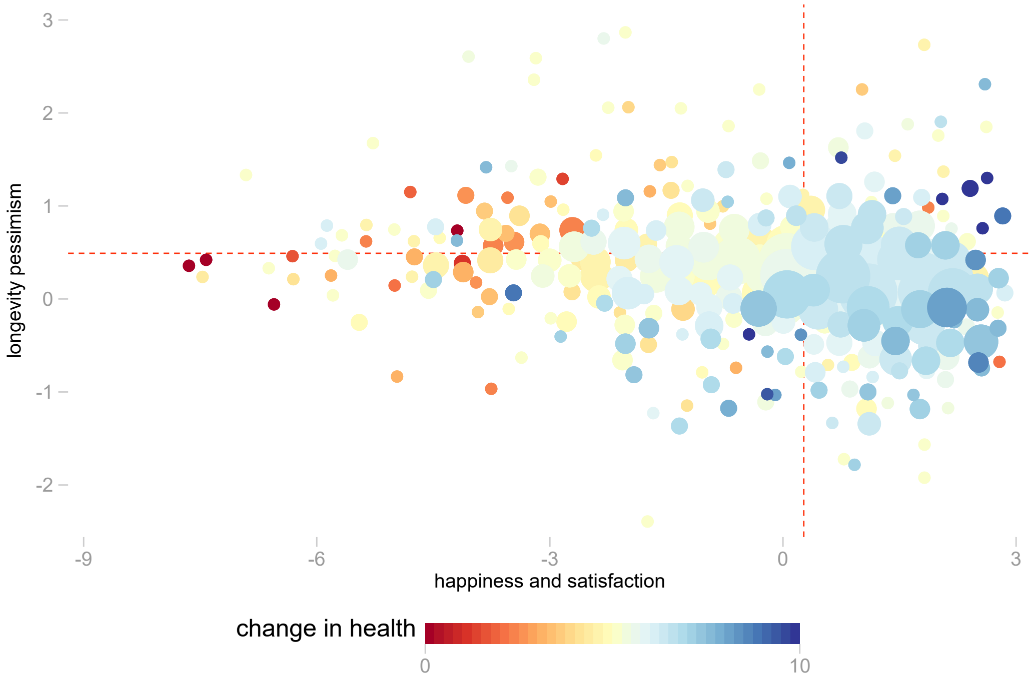


Figure 6 – Longevity Pessimism, Change in Health and Happiness. Average *change in health* (colored circles) shown according to groups of the joint distribution of subjects across longevity *pessimism* (the higher its value, the more pessimistic a subject is) and *happiness* indexes. *Change in health* is the reported twelve-month change in the health status (5 implying no change). *Happiness and satisfaction* is the first PCA component of a set of five questions on overall happiness and satisfaction with present life, life history, finances and current health.Longevity *pessimism* is modeled at the individual level for every span between current *age* and all *target age* relevant for each subject (the higher its value, the more pessimistic a person is). Sample medians highlighted in red. The area of the circles are proportional to the number of subjects within each group.