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'Biased' Risk Perceptions
of Longevity and Disability in Old Age

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Abstract:

Rational learning theories postulate that information channels and cognitive biases such as individual optimism may influence an individual's assessment of the risk of undesired events, especially with regard to those that have a cumulative nature. This is the case with disability in old age, which may take place upon survival to an advanced age, and such factors have been regarded as responsible for certain individual behaviours (for example, the limited incidence of insurance purchase). This paper examines the determinants of individual perceptions with regard to disability in old age and longevity. The cumulative nature of such perceptions of risk is tested, and potential biases are identified, including 'optimism' and a set of information determinants. Empirical evidence from a representative survey of Catalonia is presented to illustrate these effects. The findings from this research suggest a significant overestimation of disability in old age, yet this is not the case with longevity. Furthermore, individual perceptions with regard to disability in old age, unlike those with regard to longevity, exhibit on aggregate an 'optimistic bias' and, are perceived as 'cumulative risks'. Gender influences the perceived risk of disability in old age at a population level but not at the individual level, and the opposite holds true for age. Finally, self-reported health status is the main variable behind risk perceptions at both the individual and population level.

Key words: risk perceptions, cumulative risks, optimism, longevity, disability in old age.

JEL Code: I12, I11, and D81.

Abstract:

Les teories d'aprenentatge racional postulen que els canals d'informació i els biaixos cognitius tals com l'optimisme poden influenciar con l'individual avalua situacions no desitjades, especialment quan aquestes tenen un efecte acumulatiu. Aquest és el cas de la discapacitat en edats avançades, especialment la que es produeix condicionada a al supervivència a aquesta edat. Aquests factors s'han apuntat com a responsables d'algunes conductes (com ara reduïda assegurança per aquestes contingències). Aquest article examina els determinants de les percepcions de risc de dependència i supervivència en edats avançades. La naturalesa acumulativa d'aquestes percepcions es testa i alguns potencials biaixos s'identifiquen, incloent "l'optimisme" així com alguns determinants informacionals. La evidència empírica d'una mostra representativa de Catalunya il·lustra aquestes efectes. Els resultats indiquen una sobreestimació significativa del riscs de discapacitat en edats avançades però no el ris de longevitat.   A diferència de les percepcions de ris de longevitat, les percepcions de risc de discapcitat en edats avançades es perceben com a « riscos acumulatius . Les diferències de gènere en la percepció de risc poblacional de discapacitat en edats avançades però no les individuals. Finalment, l'estat de salut actual és la principal variable que explica les diferències de percepció de risc tant individuals com poblacional.

Paraules clau: Percepcions de risc, riscos acumulats, optimisme, longevitat, discapacitat en edats avaçades.

1 Introduction

The progressive lengthening of human life increases the likelihood of exposure to certain risks to life and health, including those related to longevity and disability in old age. Yet, when one considers that some protective actions (for example, insurance purchase, income replacement plans, lifestyle changes, etc) are based upon an individual′s perception of risk, the importance of how we individuals assess the frequencies of such undesired events becomes apparent. Risk perceptions contain ‘key private information′ on an individual′s potential responses to risks (McGarry, 2003), which are found to be the most important factors behind responses to risk (Weber and Milliman, 1997). With this in mind, behavioural responses to the risks of population aging in a setting of rapid socio-economic change are highly dependent on the way in which people perceive the risks arising from survival to an old age and disability . However, there are reasons to believe that people have difficulties in anticipating the potential adverse consequences of undesired events both to themselves and population as whole. This would be expected in the case of disability in old age, given that it takes place cumulatively upon an individual′s survival into old age. Yet, significant research findings indicate systematic discrepancies between ‘objective′ and ‘subjective′ risk evaluations (Slovic et al., 1981, 2000; Fischhoff et al. 1978), so that perceptions of risks are a function of objective risk information and a set of ‘biases′ (Lichtenstein et al. 1978; Kasperson et al., 1988).[1].

The cognitive biases in question include an individual′s tendency to perceive more intensively ‘high probability low cost′ events (Slovic et al., 1977; Kunreuther and Slovic, 1978)[2] and those that are taken involuntarily (e.g., risks of terrorism or pandemics) or that are seen as inequitable (e.g., risk of malnutrition). A well known bias stems from the (under)overestimation of (un)publicised (for example, the risks from smoking) risk information (Viscusi, 1997) . Other possible explanations refer to the existence of ‘availability effects′ (Tversky and Kahneman, 1974; Slovic et al, 1982) so that frequently

[1] Risks perceptions are affected by biases that are individual specific. Lichtenstein et al. (1978) find evidence that suggests that people appear to hold biased knowledge of risk frequencies due to a ‘disproportionate exposure, memorability, or imaginability of various events'.

[2] Fischoff et al. (1977) report the educated perceptions of the annual frequency of death in the USA from 40 different hazards

occurring events are generally easier to imagine and recall than are rare events. Furthermore, as has been found for other health risks (Weinstein and Klein, 1996), individuals might be ʻoptimisticʼ with regards to their life span leading to deviations to their statistical life expectancy (Purim and Robinson, 2005) or with regard to the possibility of an old age without disability. Finally, information updating sources and individual characteristics associated with time or risk preferences, age or gender, are likely to influence subjective probabilities of undesired events (Dominitz and Manski, 1997).

Subjective probabilities or risk perceptions can be elicited from survey responses to obtain subjective survival probabilities (Hurd and McGarry, 2002; Hamermesh and Hamermesh, 1985; Gan et al. 2003), mortality risk perceptions (Hakes and Viscusi, 1997) and hazard-related risks (Viscusi, 1990, 1992). Although some studies question probabilistic thinking on cross-cultural grounds (Wright and Phillips, 1980), I believe that the exisitng evidence provides a reasonable account of an individualʼs capacity to make subjective jugments and evaluations of risks. Yet, the assessment of subjective probabilities and perceptions with regard to future disability in old age is a complex task, though an important one in order for individuals to undertake preventive actions. Subjective probabilities are based upon individual learning and information updating, which in turn are affected by systematic biases, such as an overestimation of small, involuntarily taken and widely publicised risks (Viscusi, 1990). Slovic (1987) identifies significant discrepancies between the public perceptions of risks and the risk assessments carried out by experts. Hence, the subjective probabilities of survival appear to be consistent with life tables (Hurd and McGarry, 1995).[3] Finally, Hurd and McGarry (2002) find that individuals modify their subjective probabilities of survival in response to new information (for example, the onset of new illness),[4], the same is found in other studies that take risk factors into account

[3] However, Walley (1991) reviews cases in which individuals consistently respond in the lower and upper ends of the probability tails when asked questions about probabilities, suggesting that numerical probabilities elicited in surveys may be consistently biased toward extremes.

[4] However, estimates were affected by focal responses whereby some individuals reported either a 0 or 100% chance of a future event. The same applies to Gan et al. (2003), who use a Bayesian update model to account for problems associated with focal responses.

(Schoenbaum, 1997), or in which information acquisition (e.g., schooling) and individual-specific determinants are controlled for (Hurd and McGarry, 2002).[5]

Should individuals fail to perceive such risks, they would fail to self-insure (for example., by not saving enough) for their possible needs in old age (Finkelstein and McGarry, 2003). Hurd and McGarry (1997) find that the subjective probability of survival reduced the probability of doctor′s visits. Hence, decision-making regarding the likelihood of disability in old age, and consequently the exposure to (and foresight with regard to) age-related risks depends heavily on how individuals assess the risks of living until a certain age ($\pi(LE)$) and, conditioned on the former, of being disabled at that age ($\pi(D/LE_{age})$).

This paper empirically examines the distribution and determinants of subjective probabilities of disability in old age and longevity using a survey representative of Catalonia (Spain), released in 2000, to elicit perceptions regarding disability in old age and longevity. I empirically investigate the following research questions:

RQ1. *How do subjective probabilities (perceived risks) of disability in old age and longevity compare to publicly released (objective) risk estimates?*

(This could provide evidence on the extent to which perceptions of risks are biased when taken as a whole)

RQ2*. Do an individual′s perceived risks* $(\pi(D_i, LE_i))$ *deviate from population risks?*

(This could be the case as a result of optimistic beliefs with regard to the individual′s life as compared to that of others).

[5] Current health is found to determine survival risks in Hurd and McGarry, (2002).

Next, I scrutinise the determinants of an individual's risk-learning process and the connections between perceptions of longevity risk and the risk of disability in old age. Accordingly, I test further three additional research questions as follows:

RQ3. *Perceptions of disability in old age are a cumulative risk so that perceptions of disability in old age should be the result of two separate processes:*

$$\pi(D_{80}) = \pi_t(D / LE_{80}) \cdot \pi_t(LE_{80})$$

RQ4. *Perceptions of longevity and disability in old age are exposed to different information sources causing distinct cognitive biases to arise.*

(This hypothesis is drawn from the fact that while information on life expectancy is widely available, information on individual disability in old age is not, given that it is a conditional or cumulative risk as it implies survival into old age and, on the other hand, that information is subject to significant technical barriers.)

RQ5*. The determinants of individual perceptions regarding 'their own risks of disability' and perceptions of the 'risks of disability at the population level' are influenced by different private information sources.*

(This hypothesis states that individuals would be expected to have access to private information on their own exposure to disability in old age that is not publicly available and again, given its cumulative nature, one might expect that the relevant information sources that lead to risk learning would be likely to differ across individuals.)

The structure of the paper is as follows. In the next section I review the relevant literature on perceptions of disability and longevity risks, including the specific cognitive biases that are found in the literature. Section three outlines the data and methods. Section four presents the results and section five concludes.

2. Background

2.1 Cumulative risk perception determinants

Perceptions of risks to life and health are potential drivers of an individual's lifetime decisions and actions. Indeed, there are widely acknowledged financial and health-related risks linked to disability (for example, the need for long-term care) and longevity (for example, income replacement) that emerge gradually rather than all at once. However, the risks of disability in old age can be classified as 'cumulative'. That is, disability in old age cannot be separated completely from an individual's probability of survival until old age. Therefore, any failure to adequately perceive the risks that one faces would impact on the subsequent perceptions of risk. Hence, it is important to examine whether individual perceptions correspond to objective risks so as to identify any appreciable biases in individual perceptions. On the other hand, the informational channels that an individual uses to update their information can be identified, at least through individual characteristics proxying conveying such information. Moreover, this will enable me to identify whether longevity and/or disability risks which are subject to different publicity, that differ in magnitude and likelihood, are any different.

Empirical evidence from comparisons of perceived and objective risks offer fundamental insights into people's views and reactions in the context of risks, some examples are as follows. Benjamin and Dougan (1997) find evidence that people form their perceptions of population death rates from privately held information, and in particular age-specific death rates, which determine individual's perceptions regarding their own longevity. Interestingly, they find that individuals compare themselves to other individuals of a similar age. Furthermore, Hakes and Viscusi (1997), by using a Bayesian learning model combined with a quantile regression approach, identify other relevant sources of information such as discounted life expectancy. Previous studies reveal that risk perceptions vary with an individual's age as with personal characteristics associated with the subjective rate of time preference (Viscusi, 1991). Therefore, in analysing how people perceive the risks of longevity and disability, there may be a need to examine specific sources of private information along with individual age, individual- education attainment, since this influences the cost of updating information and, especially, whether the risks to the individuals are explained by similar information sources to those that are pertinent to society as a whole.

The latter points to an important distinction between individuals regarded as holding unobservable (private) risk information and awareness and those who do not. Individuals often exhibit a tendency to view themselves as invulnerable (or less vulnerable than others) to experiencing negative life events, leading to what is termed an 'optimistic bias'. This is particularly the case of those risks that show an increased level of perceived controllability (Taylor, 1989; Weinstein, 1982, 1984, 1987; Klein and Helweg-Larsen, 2002). Therefore, the risk-learning process systematically differs across risks (e.g., subjective probabilities). Therefore, population risk is often preferred when compared to individual-specific risks, which suggest evidence of an 'optimistic bias'.

One key feature to examine is the extent to which information influences both perceptions of survival and disability in old age. The rational individual's expectations of longevity are sensitive to individual information channels; mainly those that are fundamentally age dependent (for example, experience), gender dependent or education dependent, which would be expected to affect the understanding of those risks determined by educational status. Finally, healthy individuals may exhibit optimism over their future health, which might in turn have an ambiguous effect on risk perceptions with regard to disability in old age. Indeed, one might hypothesise that the healthier an individual is the more likely they are to perceive the risks of greater longevity and the less likely they are to perceive the risks of disability in old age.

2.2 The Bayesian Learning Model

Possibly the most widely accepted model to conceptualise the process of information updating is the Bayesian Learning Model. According to that model, one might expect risk perceptions to be informed by public as well as private information sources (for example, the incidence of disability in old age among their relatives), including the individual's own experience and technical information sources (for example, one might expect that more educated individuals are more likely to update their perceptions of risk).

Let us denote the value of individuals' risk beliefs (e.g., subjective probabilities) of disability in old age (and longevity) as $\pi(D_i),\pi(LE_i)$, which results from a "mental accounting" of the objective probability of disability (and longevity) Assuming a linear Bayesian learning model, individuals' risk beliefs are envisaged to be the result of a learning process, so that perceptions depend on the content of different information sources α_i , which in turn have an effect on individual's cognitive weights. Theoretically, information content is viewed as equivalent to draws from an urn (Viscusi, 1992). Individuals exhibit prior beliefs q_i with regard to specific undesired events such as disability in old age, the information content of which is updated with public (I_{pu}) and private information (I_{pr}). The resulting functional form is:

$$\pi(D_i),\pi(LE_i) = \frac{\alpha_1 q_i + \alpha_2 I_{pu} + \alpha_3 I_{pr}}{\alpha_1 + \alpha_2 + \alpha_3}$$

(1)

where $0 \le \alpha_i$. By parametrising risk perceptions and adding an error term we obtain:

$$\pi^{d,l*} = \beta_1 q_i + \beta_2 I_{pu} + \beta_3 I_{pr} + \varepsilon_i \qquad (2)$$

where each coefficient β_i is interpreted as the 'information content', namely information respective of individual prior beliefs, public information and private information as follows:

$$\beta_i = \frac{\alpha_i}{\alpha_1 + \alpha_2 + \alpha_3} \qquad (3)$$

.

Equation (2) provides an explanation of how individuals update their knowledge with regard to undesired events. Information acquisition is subject to *individual level costs* (for example, educational skills). The influence of *experience* (measured through an individual′s age) is important in that it determines the level of personal experiences that could influence the perception of an individual′s likelihood to experience an undesired event; for example after seeing a relative′s disability first hand the perceived risk might be greater. Finally, individuals differ in their attitudes towards risks, which is likely to influence how people react to the presence of risks, and ultimately influence *risk awareness*. Here is important to note that there is evidence that suggests that gender might well lead to differential attitudes to risks (Gustafson, 1998). At the individual level, there is significant information that is individual specific and that does not apply to society as a whole. Indeed, past behaviour and lifestyles do not necessarily compare across individuals, and accordingly the probability of an individual surviving into old age and being disabled upon survival might be significantly heterogeneous. Therefore, *individual perceptions of risks would be expected to rely on different determinants to those of the population estimates, given that individuals hold individual-specific information that may make ′optimistic′ on the basis of private information that they have to hand.*

3. The Data and Methods

3.1 The data

The data were collected from a computer-based survey commissioned to a specialised company that was specifically designed for this study in July 1999. A specialist market and opinion research firm carried out 400 computer-based interviews based on a questionnaire designed by this author. Although the sample might be regarded as relatively small, it is representative of the provinces of Catalonia. The questionnaire contained questions on the chances of future disability in old age at the population level, the individual′s own chances of disability during old age, as well as the probability of survival as defined below. No major problems of missing data were encountered and no major differences were found when socio-economic characteristics were compared to the Catalan Health Survey and other official statistical data. See Table A1 for a summary of the main explanatory variables employed.

The three main questions of interest in this study were the respondents′ assessments of the chances of an individual becoming disabled by the age of 80 on a scale of 0–100, along with their perceptions regarding the possibility that they might experience disability at that age and their expected probability of survival. Following previous studies (Viscusi, 1992, 1991) the individual risk perception was elicited from the individual′s response to the following question:

′Out of 100 individuals, how many would be disabled at 80 years of age?′

The answers to this question provided some information on the individual′s probabilistic assessment of disability in old age by normalising the responses to [0,1] and where respondents were given the World Health Organisation (WHO) definition of disability, along with examples such as Alzheimers disease and cognitive impairment.[6] The advantage of the risk perception elicitation method is that responses can be interpreted as subjective probabilities. Furthermore, this elicitation method is commonly used in estimating subjective probabilities (Viscusi, 1990, 1992; Hurd and McGarry, 1995; Hayakawa et al., 2000). One drawback of this method may be the individual difficulties in conceptualising mathematical probabilities of adverse outcomes (Slovic et al., 1987). However, even when individual risk perceptions may not be correct, their existence exerts some influence on individual behaviour and might reflect the extent to which the information held by an individual might affect their behaviour. On the other hand, some other studies question the existence of a systematic bias when probability question formats are used and they suggest instead that ′verbal measures′ of risks might be employed (Windshitl, 2002). However, verbal measures of risks might be more likely to be influenced by the wording of response scales and by irrelevant information. Moreover, numerical assessments of risks do not

[6] The specific card provided to the interviewer included several potential causes of disability in old age offering (although not necessary assuring) a clear idea of what disability means. The aim was to inform the respondent rather than focus their attention on a specific event. Furthermore, there is evidence in the risk perception elicitation literature of the existence of ‘scope effects’ in that the explicitness of the alternatives is likely to bias the results (Windschitl, 2002).

provide evidence to inform decision-making models that are normally employed by economists.

The individuals' subjective probability estimates of being disabled at the age of 80 are compared as a conditional probability as follows. In a population of N_i individuals of a given age, the expected number of survivors would be N_j, where j refers to the reference age. Thus, if the reference age is j, then the expected survival until age 80 would be $S_{i80} = \frac{N_{80}}{N_i}$. Similarly, the expected number of disabled members of a given population at age j is D_{ij}, which at the reference age would be conceptualised as the conditional probability of being disabled should one survive to that age $d_{i80} = \frac{D_{i80}}{N_{i80}}$. Estimates from Spain suggest a probability of 0.42 for females and 0.38 for males of being disabled in old age in Spain, which I will refer to as 'objective probability' estimates.[7]

In addition to the population disability risk perceptions, individuals hold 'private information' (Hurd and McGarry, 2003) on their own probability of disability, based on their perceived health status or unobserved past behaviour. Therefore, one might expect individuals to have 'optimistic' perceptions regarding their own risk of facingdisability in old age if their private information leads them to believe that their own probability of disability in old age is lower than that of the population in general. In order to investigate whether an individual's subjective perception of disability risks differs from the subjective probability of survival I analysed the answers to the following question:

'Do you think that you will be disabled during old age at the age of 80?'

Respondents were given examples of what disability in old age might mean, such as having Alzheimers disease and cognitive impairment, among other specific conditions. This

[7] However, these estimates should be conceptualised as 'maximum risk perception estimates'. Yet the hypothesis of morbidity compression suggests that morbidity declines as life expectancy increases (Fries, 1980). Sensitivity analysis using data from Spain among other countries indicates that depending on the

question allows one to estimate the presence of a potential optimistic bias. Yet, in understanding disability in old age, this scenario assumes that individuals will live to that age. Therefore, insofar as disability in old age is conditioned on the individual's survival, the questionnaire included a question on the subjective probability of survival as follows:

'*How long do you expect to live?*' (in years)

From the above question it is possible to identify those individuals that do not expect to survive until the age of 80, and accordingly for whom the possibility of disability in old age might not be relevant.[8] Interestingly, the latest mortality tables from 1999 suggest a life expectancy of 75.3 for males and 82.2 for females. United Nations' forecasts attribute to Spain a forecasted life expectancy of 78.5 for males and 84.8 for females. Female life expectancy in Spain is the highest of all EU countries, and is surpassed only by Japan. The probability of survival should increase with age given that infant mortality declines over time. On the one hand, some evidence from Spain indicates that the probability of dying at the age of 75-80 seems to have declined. Yet, life expectancy at age 65 between 1970 and 1999 has increased by 24.5 per cent (Abellan Garcia, 2005).

Following the predictions of the simple Bayesian learning model outlined in the previous section, I examined the influence of demographic characteristics, health status, gender, education and household size in determining perceptions with regard to disability in old age, and the subject's own chances of disability and longevity.[9] However, there is evidence that brings this assumption into question. Gender has been found to be a significant determinant in previous studies, which have found that females tend to perceive higher risks (Viscusi, 1990, 1991, 1992). Education is a key determinant in that it proxies the amount of information that individuals have as well as the costs of information acquisition. Household size was included in the model as being a source of private information. As discussed in the previous section it is

assumption of the effect of morbidity on old age disability, these estimates might decline by between ten and 23 per cent (Rothgang and Comas, 2003).

8 It should be noted that this is a relatively common question phrasing employed in several studies (Purim and Robinson, 2005). However, given that individuals differ in their predisposition to greater longevity, one of the main challenges of empirical studies is the correction of these measures.

9 This is consistent with insurance studies; the probability of experiencing losses is not directly observed, instead the probability of loss is proxied by age, gender and pre-existing beliefs (Showers, and Shotick, 1994).

plausible to assume that the individual's health status influences expectations regarding disability and longevity. Finally, because prior beliefs were not observed these were interpreted as the interception of the regression following Viscusi (1992).

The determinants of disability and life expectancy at the population level were estimated using OLS. Moreover, sample selection (Heckman, 1979) was employed to examine the hypothesis of sample selection between perceptions of survival until the age of 80 and perceptions with regard to disability. Therefore, the so-called inverse mills lambda (λ) obtained from the ration of the density and the distribution function of previous regression examining perceived survival at old age was introduced. Should this be found to be not significant it would imply that it would make no difference to the coefficients to estimate each model separately. On the other hand, perceived risks at the individual level were measured by a discrete function so that the determinants of the individual's own perceptions regarding disability were examined using a probit model, and by the same token as before, I account for potential sample selection given the hypothesis of the 'cumulative nature of old age disability risks'. Sample selection is equivalent as before but a probit model was employed to control (Van de Ven and van Praag, 1981), whereby the significance of the coefficient ρ indicates the presence of sample selection and, accordingly, the empirical confirmation of the 'cumulative nature' of individual risks. .

4 Results

4.1 Perceptions of Longevity and Disability in Old Age

Table 1 reveals that although 'objective' life expectancy from official estimates (Spanish Institute of Statistics) is lower for men (74.9) than for women (82.4), only *older women overestimate their life expectancy whereas all male age cohorts tend to overestimate their life expectancy.* Again this is consistent with previous research, suggesting a gender bias in risk perceptions (Gustafson, 1998). Interestingly, perceived life expectancy increases with age both for men and women. Women generally give higher probabilities of survival than men, as would be expected, although the differences found were less than those recorded in survival tables (***RQ1***). An explanation given in several studies, including that carried out by Hurd and McGarry (2002), is that individuals adjust their estimates by taking into account the experiences of those people in their own environment rather than adjusting by gender. Roughly 70 per cent of respondents believed that they would survive beyond the age of 80. Interestingly, responses registering a zero or one value, referred to as ‘focal responses’ (Gan et al., 2003) accounted for less than five per cent of the total – 1.3 per cent gave a subjective probability of zero and 3.3 per cent gave a subjective probability of one.

[Insert Table 1 about here]

4.2 Biases in Risk Perceptions of Disability in Old Age

I begin by reporting the effects of age and gender on perceptions of the risks of population disability, and an individual′s own disability and longevity, as displayed in Table 1. Here I examine the influence of three different effects. First I look at the difference between probability risk perceptions and an individual′s risk perception of disability in old age, which I refer to as ‘optimism’. Then I examine the evidence of gender biases and age-specific patterns.

On average, the perceived risk (probability) of disability at the age of 80 is about 0.48 – or 48 in percentage terms are displayed in Table 1 – at the population level in Spain. Hence, at first glance one could conclude that both exhibit a slight overestimation of old age disability risks. Furthermore, only 20 per cent of respondents perceived that they personally would be disabled by the age of 80, which provides preliminary evidence of an aggregate ‘optimistic bias’ in risk perceptions. That is, *individuals tend to perceive higher risks to society as a whole – estimated in probability terms – as compared to those perceived as affecting them alone (**RQ2**).*

Among women estimates were as high as 51 per cent and among men they declined to 45%. Therefore, one could argue that there is a ‘gender bias’ in risk perception estimates on that basis, although not all the differences should be exclusively attributed to cognitive biases. Indeed, if individuals compare themselves with other individuals of the same gender, then estimates are arguably less affected by cognitive biases but might instead have different points of reference. Given that women live longer and are more likely to become disabled, it is possible that individuals might be able to discriminate on the basis of their gender (**RQ 4**). Yet, on comparing gender specific differences between perceived and objective risks *both genders were found to overestimate their objective risks; more specifically men do so by seven percentage points and women by nine percentage points*. Thus, even though there is evidence of a gender difference in risk perceptions (Gustafson, 1998), once adjusted by their gender-specific rates – which assume that a gender-specific risk learning process is present – part of that gender difference could well be attributed to some gender specific knowledge of a real risk of disability in old age. Interestingly, when the gender effects of disability risk are examined for different age groups, no significant gender differences are found between men and women below the age of 45, while there is roughly a 20 per cent difference between older men and women, which exceeds the roughly 10 per cent difference in objective risks. Table 1shows that women seem to perceive a higher risk of their own disability; and here the difference is as much as 0.12 points – 0.15 of men and 0.27 of women see themselves as being disabled in old age. Accordingly, previous evidence suggests a gender bias in general risk assessments; this evidence is further enforced when risks are examined as affecting individuals exclusively. Again, gender differences were not significant for respondents aged below 45, while differences become more marked the older the individuals interviewed were. Therefore, *we can conclude that gender biases in the perception of the risks of disability in old age tend to be concentrated among respondents from the middle and older age groups*.

The findings from this research indicate that perceptions of the risks of disability in old age are relatively high among the younger cohorts and drop significantly later on, indicating possibly the effect of information updating (for example, experience with old age disability) that may have led them to reduce their estimates and adjust their cognitive biases accordingly. Among other age groups, it was found that the perceptions of disability risks remain at a value that it is not significantly different from that of average risk perceptions (**RQ 4-5)**. However, it should be noted that *the dispersion of risk perception estimates decreases with age*, which is consistent with prior evidence, indicating that older people rely more on heuristic processes and less on analytical strategies (Yates and Patalano, 1999).

Turning the disability risk perceptions examined in this research, the results indicate that there is a clear aggregate age-related pattern that smoothes out after the 45-64 age group. However, this pattern was found to hold only for females, therefore proximity to the risks of disability in old age does not seem to influence the perception of risks among men, while it does seem to be the case among women. This implies that, while among females perceptions of their own risk of disability declines with age, the perceptions among males exhibit a U-turn whereby middle-aged men are less optimistic with respect to their chances of experiencing disability in old age than other male age cohorts (***RQ5***).

4.3 The Distribution of Disability Risks

The risk distribution indicates that risk perceptions are, in general terms, symmetrically distributed (see Table 1 and 2). However, it does not seem reasonable to assume that 100 per cent of 80 year-old individuals will be disabled at old age. Some 80 per cent of the sample registered risk perceptions ranging from 0.2 to 0.7. While any assessment of potential bias depends on what one defines as disability, taking into account the evidence of objective risks and when disability is understood to be a state in which there is some form of limitation, the results show that people overestimate the risks of disability. This is *consistent with the accepted idea that people tend to overestimate high cost and small probability events* (***RQ1***)

[Insert Table 2 about here]

4.4 Risk Learning Determinants

Perceptions regarding disability in old age, the individual′s own risk of disability and longevity are examined in Table 3. Consistent with prior evidence, male respondents exhibited lower risk perceptions as did middle-aged subjects. Because, in general, individuals tend to overestimate the risks of disability, it does not seem that middle-aged individuals fail to perceive the risks as compared to other age cohorts. On the contrary, this evidence would suggest that middle-aged respondents are those who are least likely to overestimate the risks. On the other hand, household size is not significant, while *higher risks are perceived by respondents with a lower level of education attainment*, which in turn provides evidence on the role of information costs in updating risk information. As expected, the state of individual health exerts a significant influence, whereby the healthier the individual the more 'optimistic' they are, and thus the less likely they are to perceive higher risks. The significance of the intercept term might indicate the significance of other sources of information, such as prior beliefs, which are not observable to the researcher. Now, one might argue that there is sample selection, whereby those assessing a high disability risk are those that expect to survive beyond the age of 80. However, the λ coefficient was found to be non-significant indicating no evidence of individual sample selection. The usual misspecification tests were undertaken and overall the model exhibits a 12 per cent R^2.

[Insert Table 3 about here]

Table 3 displays the results of the probit model with sample selection for the individuals' perceptions with regard to their own personal risk of disability. As hypothesised, significant differences were found when these data were compared with the determinants of the previous risk perceptions question (***RQ4-5***). Interestingly, optimism is associated with lower education levels and a higher health status, while neither age nor household size have any appreciable influence. It is worth noting that in this case there is evidence of sample selection in that the ρ is significant and the Log Likelihood Test does reject the hypothesis of ρ being zero, suggesting that a risk perception estimate would be biased unless it takes into account the potential sample selection that can be attributed to an individual's perception that they will not live until the age of 80 (***RQ3***). In other words, *the risks of disability in old age can be seen as cumulative risks that result upon survival at old age.* The significance of the sample selection parameter implies that controlling for the cumulative nature of such risks would reduce the statistical biases in estimation.

An examination of life expectancy perceptions indicates that, consistent with preliminary evidence, there is an age-related bias (**RQ4**). That is, the older the individual is the higher their life expectancy, which might be counterintuitive judging by the observed increase in life expectancy at birth. However, because the cohort of individuals over the age of 65 is taken as the omitted dummy variable, this suggests that in*dividuals close to the reference age of 80 might be more optimistic about living longer*. On the other hand, gender is not significant, which might indicate that individuals do not necessarily distinguish gender-related information on life expectancy. Moreover, this feature can be explained by the increasing information and awareness on the population aging process. Interestingly, self-reported health status exhibits a positive and significant coefficient, revealing that individuals who see themselves as healthy expect to live longer.[10]

Table 3 displays the determinants of perceptions regarding survival until the age of 80. Again, younger individuals are less likely to believe that they will survive to that age, while healthier individuals are more likely to believe that they will survive until the age of 80 (***RQ5***). Finally, gender, education and household size appear not to be significant, which is consistent with prior results on life expectancy perceptions.

5. Conclusions

This paper has attempted to empirically examine how individuals form their perceptions regarding longevity and the risk of disability in old age. I have set out to examine a set of research questions on the nature of perceptions of such risks and the associated information determinants. As expected, perceptions with regard to an individual's risk of disability in old age are affected by prior perceptions regarding that individual's chances of survival until old age, which backs *the 'cumulative' risk hypothesis of disability in old ag*e. Therefore, the perceptions of risks with regard to disability in old age are seen to be the result of a mental accounting process that adjusts the probability of survival into old age

[10] Yet, this finding might well be explained by the presence of some omitted variable, capturing individual 'optimism', explaining both perceptions of longevity risks and health status.

and that of experiencing a condition recognised as disability upon survival.[11] Although individuals tend to exhibit a relatively a*ccurate perception of their own life expectancy*, they conversely *'overestimate' the risks of disability to the general population*. This feature could be explained by the presence of some 'availability effects' (Tversky and Kahneman, 1974; Slovic et al., 1982), given the ample information available on longevity risks compared to that available on disability in old age. O*n average barely 21 per cent of the respondents expect themselves to be disabled in old age, while they expect (on average) 48 per cent of the general population to experience disability in old age*. Hence, on average a vast majority of respondents exhibit *'optimistic expectations' with regards to undesired events of disability in old age*. This is consistent with some prior evidence on smoking and health-related risks (Weinstein, 1982, 1984, 1987). However, *perceived longevity (optimism) increases (declines) with proximity to old age* whilst (optimistic) perceptions regarding disability in old age are lower (larger) among men.

Perceptions with regard to both life expectancy and disability are influenced by different information channels, when examined at either the individual or the population level. The only variable that was significant, irrespective of the questions examined, was self-perceived health. One explanation might be that, having compared themselves to others, healthier individuals perceive that they have a greater chance of a longer life without disability. Another explanation might be that healthier individuals might be less likely to imagine themselves disabled in old age and are more likely to see themselves as living longer. This is consistent with the findings of McGarry (2003), suggesting that risk perceptions convey a specific source of private information that influences individual perception on health. However, an alternative explanation might be that optimism simultaneously affects both risk perceptions and self-reported health status.

Age has no significant influence on individual perceptions with regard to disability in old age (at the population level), while conversely, it does have a negative effect on perceptions of longevity, meaning that the older one becomes the more likely it is that one will expect

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[11] Accordingly, despite the cumulative nature of disability risks, one might expect that biases affecting longevity will not have a significant effect on the perceptions of risk with regard to disability in old age.

to live longer as compared to a reference group, which is unknown but likely to be other individuals of similar age cohorts. One potential explanation for this effect may be the differential perception depending on the proximity of the risk, whereby risks turn from abstract to concrete (Trope and Liberma, 2003). However, no evidence was found to suggest a gender effect in explaining life expectancy perceptions or the probability of survival until the age of 80. This would generally be seen as inconsistent with the evidence that women tend to live longer, which could imply that respondents do not take their gender into account when reporting perceived life expectancy estimates.[12] An alternative explanation would be that compared to disability risks, longevity risks are more familiar due to the publicity with regard to the aging process.

Interestingly, education had a greater influence on perceptions with regard to an individual risk of disability than on the perceptions of risks to the general population. Finally, the individual′s current health status showed a positive correlation with their perceived longevity and a negative correlation with the perceptions of disability risks at the individual and the population level. Education was found to be a significant predictor of the perceptions of the risk of disability in old age. Following the predictions from the Bayesian learning model, it is likely that insofar as it conveys information, education should lead to a reduction in individual optimism. However, given the nature of our data, some arguably relevant information sources, such as personal contact with disability and death, may not have been fully accounted for. For instance, one might argue in favour of genetic links that might be unobservable. Furthermore, there is some evidence that the recent death of a relative or a spouse might affect an individual′s subjective probability (Hurd and McGarry, 2002). However, in explaining disability risks one might argue that a perceived risk of early death might lessen the perceived risk of suffering from disability in old age. Therefore, in dealing with issues of self-protection and insurance to cover such risks, other relevant factors may need to be taken into account.

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[12] Given that women tend to live longer, the findings suggesting no gender difference indicate once again that women might even be underestimating their life expectancy, since they may not be taking their age

There is evidence to suggest that a lack of insurance coverage for financial risks associated with longevity and disability is the result of an institutional failure to persuade individuals to consider the risks while they are still young, healthy and affluent.[13] This empirical evidence does not allow one to assert that individuals are unaware of their future risks with regard to disability in old age and longevity, although individuals' optimism over their own risks of disability in old age – compared to those they believe are faced by others– appears to be a systematic feature, depending on education and current health status. The perception of risk with regard to disability in old age might be relatively unfamiliar and subject to significant uncertainty insofar as the aging process is a relatively recent phenomenon in southern European countries such as Spain. Finally, when considering the risks of disability in old age, individuals might be in possession of erroneous information with regard to the extent of public support available and the potential risks that they face.[14] Even in a scenario in which individuals are in receipt of accurate information about what is publicly covered, some might believe that, ultimately, someone will take care of them (Postner, 1995). Finally, it is important to stress that perceptions of life expectancy and disability in old age are not necessarily a pleasant experience and, therefore, it might well be the case that a certain proportion of the population have no clear cut view on such matters, especially at younger ages.

Some caveats of the study might be worth mentioning. First and foremost, it is important to note that perceptions of longevity and disability risks are culturally or nationally dependent and therefore they cannot be totally extrapolated to all countries. In western countries such as Spain, existing social protection and welfare state mechanisms might lead individuals to feel safer with regard to possible health or population-related threats. On the one hand, one might well argue that the wording of risk perception questions is a limitation to empirical analysis, for instance some individuals might experience a differential reaction in response to the word 'disability' and might, from experience, have a different view of what 'old

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specific life expectancy as a reference point, but rather other forms of information from their own social network or experience.

[13] Indeed, McCall et al (1998) suggest that a lack of accurate perceptions of the risk of needing long-term care inhibits consumers from considering insurance or alternatively may distort the calculations that individuals make.

age' might be. Yet, it is worth noting that 'focal responses' accounted for about four per cent of total responses, therefore some bias might be present in the empirical estimates. However, this is the first study carried out in Spain on risk perceptions with regard to longevity and disability in old age. Thus, future research might well need to address some of these issues along with others not explored here, such as the knowledge of insurance coverage for age-related financial risks.

[14] Indeed, Rivlin and Weiner (1988) found in a US study that during the 1980s more than a quarter of the population thought that the Medicaid paid for long-term care.

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Table 1: Longevity and Disability Risk Perception Estimates (mean and standard errors)

	Total		Male		Female	
a) Population Old Age Disability Risk Estimates [$\pi(D)$] [a]						
Age	Mean	s.e	Mean	s.e	Mean	s.e
18-29	54.27	(3.11)	54.04	(4.33)	54.55	(4.56)
30-44	43.90	(2.35)	42.80	(3.90)	44.69	(2.94)
45-64	48.30	(2.01)	43.89	(2.74)	52.64	(2.86)
>64	48.34	(1.93)	43.63	(2.56)	53.79	(2.81)
Total	**48.12**	**(1.13)**	**44.98**	**(1.58)**	**51.27**	**(1.57)**
b) Own (Individual) Disability Risk Perceptions (at the age of 80) [$\pi(D_i)$] [b]						
Age	Mean	s.e	Mean	s.e	Mean	s.e
18-29	0.102	(0.044)	0.111	(0.062)	0.091	(0.063)
30-44	0.143	(0.038)	0.114	(0.055)	0.163	(0.053)
45-64	0.252	(0.038)	0.200	(0.050)	0.303	(0.057)
>64	0.243	(0.037)	0.137	(0.041)	0.365	(0.061)
Total	**0.208**	**(0.020)**	**0.150**	**(0.025)**	**0.265**	**(0.031)**
c) Perceived Life Expectancy Estimates (years) [$\pi(LE)$] [c]						
Age	Mean	s.e	Mean	s.e	Mean	s.e
18-29	81.47	(1.04)	80.85	(1.23)	82.23	(1.78)
30-44	81.69	(0.72)	82.14	(1.30)	81.37	(0.83)
45-64	83.92	(0.55)	84.00	(0.90)	83.85	(0.66)
>64	85.25	(0.69)	84.15	(1.08)	86.52	(0.80)
Total	**83.61**	**(0.36)**	**83.31**	**(0.57)**	**83.91**	**(0.46)**
d) Perceived Life Expectancy over the age of 80 [$\pi(LE_{80})$]						
Age	Mean	s.e	Mean	s.e	Mean	s.e
18-29	0.38	(0.07)	0.37	(0.09)	0.41	(0.10)
30-44	0.36	(0.05)	0.45	(0.08)	0.28	(0.06)
45-64	0.55	(0.04)	0.52	(0.06)	0.57	(0.06)
>64	0.67	(0.04)	0.67	(0.06)	0.68	(0.06)
Total	**0.52**	**(0.25)**	**0.54**	**(0.03)**	**0.51**	**(0.03)**

[a] Question: Out of a sample of 100 individuals, how many do you think will be disabled at the age of 80?
[b] *Question: Do you think you will be disabled at the age of 80?*
[c] *Question: Until what age do you expect to live?*

Table 2: Old Age Disability Risk Perception Distribution ([$\pi(D)$])

Risk Level	Frequency (s.e.)	Cumulative Frequency
Risk<0.1	0.013 (0.006)	0.013
0.1<Risk<0.2	0.033 (0.009)	0.045
0.2<Risk<0.3	0.203 (0.02)	0.248
0.3<Risk<0.4	0.103 (0.015)	0.350
0.4<Risk<0.5	0.140 (0.017)	0.490
0.5<Risk<0.6	0.108 (0.016)	0.598
0.6<Risk<0.7	0.138 (0.017)	0.735
0.7<Risk<0.8	0.160 (0.018)	0.895
0.8<Risk<0.9	0.073 (0.013)	0.968
0.9<Risk<1	0.033 (0.009)	1.000

Table 3 Disability Risk and Life Expectancy Perception Equations

	$\pi(D)$		$\pi(D_i)$		$\pi(LE)$		$\pi(LE_{80})$	
	Coef.	t-value	Coef.	t-value	Coef.	t-value	Coef.	t-value
Age 18-29	0.029	0.659	0.123	0.173	-5.344	-3.717	-0.781	-2.945
Age 30-44	-0.071	-1.997	0.285	0.531	-4.894	-4.279	-0.878	-4.156
Age 45-64	-0.012	-0.409	0.309	0.909	-1.836	-1.955	-0.301	-1.764
Male	-0.067	-3.012	-0.783	-2.9	-0.938	-1.306	0.054	0.413
Household size	0.01	0.954	-0.016	-0.127	0.01	0.031	-0.024	-0.412
Primary school	0.018	0.549	-0.971	-2.001	-1.622	-1.567	-0.147	-0.780
High school	0.031	0.766	-0.626	-1.169	-0.703	-0.541	-0.031	-0.130
Medium degree	-0.096	-2.01	-0.033	-0.05	-1.992	-1.298	-0.528	-1.832
Health status	-0.026	-2.372	-1.825	-2.791	1.076	3.055	0.174	2.699
Intercept	0.594	10.276	1.337	2.019	83.805	45.152	0.010	0.031
Pseudo R^2			0.10				0.08	
Likelihood Ratio			42.67				34.8	
Adj-R^2	0.12				0.11			
F(9,390)	5.1				3.8			
λ [1]	-29.3	0.165						
ρ [1]			-0.92	-2.35				

1. Mills Lambda (λ) and correlation coefficient of the random disturbances (ρ) denoting whether there is selectivity in the respectively continuous or discrete choice equation system.

Appendix.

Table A1. Variable Definitions and Summary Statistics (means and standard errors)

Variable	**Type**	**Definition**	*Mean*
Age 1	D	Individual′s age less than 30	0.12
Age 2	D	Individual′s age between 30 and 50	0.27
Age 3	D	Individual′s age between 50 and 65	0.27
Age 4	D	Individual′s age more than 65	0.34
Household size	N	Number of members of the household	2.68
Primary school	D	Individual has a primary school education	0.59
High school	D	Individual has an intermediate secondary school education	0.21
Medium degree	D	Individual has an intermediate university degree	0.04
University degree (higher)	D	Individual has a higher university degree	0.15
Health status	Q	Self perceived health status (1=bad health to 5=excellent health)	3.470

Notes: 1- D=dummy; N=numerical; Q=qualitative