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Decomposing social risk preferences for health and wealth

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ABSTRACT

This study reports the results of the first artefactual field experiment designed to measure the prevalence of aversion toward different components of social risks in a large and demographically representative sample. We identify social risk preferences for health and wealth for losses and gains, and decompose these attitudes into four different dimensions: individual risk, collective risk, ex-post inequality, and ex-ante inequality. The results of a non-parametric analysis suggest that aversion to risk and inequality is the mean preference for outcomes in health and wealth in the domain of gains and losses. A parametric decomposition of aversion to risk and inequality shows that respondents are averse to ex-post and ex-ante inequality in health and wealth for gains and losses. Likewise, respondents are averse to collective risk, but neutral to individual risk, which highlights the importance of considering different components of social risk preferences when managing social health and wealth risks.

1. Introduction

As illustrated by the recent COVID-19 pandemic, the increase in economic mobility during the last decades has increasingly exposed societies to a plethora of social risks (e.g., [Quiggin, 2007](#)). Such risks are social in the sense that they typically do not only involve the level of risk, but also involve inequality resulting from the distribution of risks across different groups in society. For instance, the COVID-19 pandemic exposed societies to substantial health and income risks that were primarily borne by the elderly and the non-retired, respectively ([Viscusi, 2020](#)). Designing effective public policies to properly manage social risks requires an accurate understanding of societies' preferences toward risk and inequality, i.e., preferences toward social risk. This study reports the results of the first artefactual field experiment designed to measure the prevalence of aversion toward social risks in a large and demographically representative sample. More specifically, we identify social risk preferences for wealth and health in the domain of gains and losses and decompose these attitudes into four different dimensions: viz., an individual risk dimension, a collective risk dimension, an ex-ante inequality dimension, and an ex-post inequality dimension. The results of this study inform policymakers on how to design effective evidence-based policies to manage social longevity and income risk.

To illustrate the relevance of decomposing social risk preferences for public policy, consider a hypothetical society consisting of two equally sized sectors: a healthcare sector (H) and a tourism sector (T). Average monthly wages in both sectors depend on whether a global pandemic hits or not and on whether the government decides to invest in public health surveillance that improves the government's ability to manage future pandemics more effectively. For convenience, let us assume that it is equally likely that an outbreak

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Table 1
Two social policies.

Not invest	T	H	Δ (T-H)	Invest	T	H	Δ (T-H)
Outbreak	€750	€2500	-€1750	Outbreak	€1250	€2700	-€1450
No outbreak	€2250	€2000	€250	No outbreak	€1250	€2300	-€1050

will occur or not. The decision of the government on whether or not to invest in public health surveillance is represented in [Table 1](#) below.

If the government does not invest in public health surveillance and an outbreak occurs, the mean monthly wage in the tourism sector drops from €2250 to only €750 due to a collapse of the tourism sector. At first sight, investing in public health surveillance appears to be attractive because it makes society's income more robust to a pandemic: the income risk decreases while keeping the total expected income constant. This is true for both the income risk of workers in each sector (since investing reduces the dispersion of income in both sectors) and the income risk in the society as a whole (since investing reduces the dispersion of the sum of incomes of both sectors). The extant literature has coined the first type of risk, i.e., risk concerning the dispersion of outcomes for each member of society irrespective of the outcomes of other members of society, *individual risk*. The second type of risk, i.e., risk concerning the dispersion of the total outcome of all members of society, is typically called *collective risk* (e.g., [Rohde and Rohde, 2015](#)).

Even though investing in public health surveillance makes the economy more robust to a pandemic, it can increase the income inequality in society in two ways. First, such investment increases the income difference after the resolution of the uncertainty in case of no outbreak. This type of inequality, i.e., inequality concerning differences in the final allocation of outcomes across members of society, has been coined *ex-post inequality* (e.g., [Broome, 1991](#)). Moreover, investing in public health surveillance increases the income inequality even before the resolution of uncertainty: it increases the expected average wage difference between the healthcare and the tourism sector. Because this type of inequality manifests itself before the resolution of uncertainty, this type of inequality is typically called *ex-ante inequality* (e.g., [Diamond, 1967](#)).

The extant empirical fairness literature suggests that people are generally averse to ex-ante and ex-post inequality (for a review, see [Trautmann and Vieider, 2012](#)). However, it is well-known that measurements of ex-post and ex-ante inequality attitude are potentially confounded by social planners' risk preferences. For example, the literature on public risk has recognized that collective risk seeking translates into ex-post inequality aversion when not properly controlled for (e.g., [Broome, 1984](#); [Fleurbaey, 2018](#); [Keeney, 1980](#)). In fact, [Rohde and Rohde \(2015\)](#) show that student participants of a conventional laboratory experiment display a *seeking* attitude toward ex-post income inequality when controlling for social planner's risk preferences. The purpose of this paper is to decompose observed social risk preferences in an individual risk component, a collective risk component, an ex-ante inequality component and an ex-post inequality component. Importantly, we identify the prevalence of each component of social risk preferences for income and longevity risk in a large and demographically representative sample, which allows us to extend the scope of the empirical literature on social risk in three important directions.

First, the large sample allows us to test if social risk preferences are moderated by the type (wealth vs. health) and the domain (gains vs. losses) of the outcomes by treatment variation. In our experiment, respondents either make choices between options yielding monetary outcomes or outcomes in terms of changes in life expectancy in a between-subjects design. Moreover, by framing the outcomes in either improvements or in reductions in wealth and longevity, we test for potential domain-dependence of the behavioral motives underlying social risk preferences. Given that many important social risks (such as the risks of global warming) concern the allocation of burdens rather than benefits, measuring social risks in the loss domain is highly relevant for public policy. [Abásolo and Tsuchiya \(2020\)](#) study the prevalence of attitudes toward ex-post inequality and social risk (individual and collective risk combined) for health and wealth outcomes in the loss domain. Their results indicate that the majority preference is in line with aversion toward social risk and ex-post inequality in both outcomes. We extend this finding to the gain domain, include a measurement of ex-ante inequality, and decompose social risk preferences into an individual risk component and a collective risk component.

Second, the large and representative sample allows us to identify each component of social risk attitudes accurately, and test if the results of prior experimental studies on social risk preferences using students as subjects generalize to broader populations. This is important, given that public policy should preferably be based on the prevalence of social risk preferences in a representative sample, rather than on the prevalence of preferences in a sample primarily consisting of young highly educated subjects ([Abásolo and Tsuchiya 2020](#)). [Rohde and Rohde \(2015\)](#) conclude that the majority preference of a sample of university students is consistent with aversion toward individual risk and ex-ante inequality and seekingness toward ex-post inequality and collective risk for wealth. The proneness toward ex-post inequality and collective risk is surprising, given that the opposite is often observed (e.g., [Trautmann and Vieider 2012](#)). We test whether these findings generalize to a broader population and to the health domain and find that it does not; our results support universal ex-post inequality aversion for health and wealth.

Finally, the availability of extensive background data of our participants allows us to assess the relationship between each component of social risk preferences and socioeconomic and demographic characteristics of respondents. Previous papers have for instance found that males are less averse to individual risk than females (e.g., [Rohde and Rohde 2015](#)). We test if this gender effect generalizes to a broader population and whether it is moderated by the type and the domain of the outcomes. More importantly, our large dataset allows us to relate the different components of social risk preferences to different factors besides gender.

In our study, respondents are asked to make choices between options in the role of a so-called impartial spectator (e.g., [Smith, 1759](#)). The spectator is impartial in the sense that her preferences are not affected by any personal stake in the outcomes; the choices of spectators only determine the outcomes of other members of society. As argued by [Konow \(2003\)](#), preferences of impartial spectators

f	Ann	Bob	f'	Ann	Bob	f''	Ann	Bob	f'''	Ann	Bob
$\frac{1}{2}$	5	5	$\frac{1}{2}$	10	10	$\frac{1}{2}$	10	0	$\frac{1}{2}$	10	0
$\frac{1}{2}$	5	5	$\frac{1}{2}$	0	0	$\frac{1}{2}$	0	10	$\frac{1}{2}$	10	0

Fig. 1. Four social policies.

are particularly relevant for public policy because such preferences are not confounded by selfish or strategic motives. Moreover, according to Konow (2003), spectators' preferences should form the basis of normative theories of welfare, because "any normative theory with a claim to relevance must direct actions that are sustainable in the real world of real values" (p. 1191). Thus, the results of this study directly inform policymakers on how to design evidence-based policies to cope with social income- and longevity risks that societies are increasingly exposed to, as a result of increased economic mobility (e.g., Quiggin 2007).

The results of our study show that respondents are generally averse to social risks. In both domains (gains and losses) and for each type of outcome (money and longevity), respondents prefer to avoid risk and inequality. Interestingly, aversion toward social risk is less pronounced for outcomes involving losses. A parameter-free decomposition of social risk into a risk- and an inequality component reveals that this is mainly caused by attitudes toward risk, and not by attitudes toward inequality: in the loss domain, respondents are more willing to take risk for health and wealth. A further parametric decomposition reveals that the reduction in risk aversion in the loss domain is mainly due to the fact that respondents are risk neutral for individual risks in the loss domain for both types of outcomes. These results highlight the importance of considering different components of social risk preferences when managing social risk.

In the next section, we discuss the background of our measurements in light of previous studies. Section 3 describes the experimental design, the subject pool, and the background data we use. We then introduce the treatment conditions that constitute our experiment. The treatments vary the type of outcomes (health and wealth) and the domain of the outcomes (gains and losses). In Section 4, we present the results regarding the prevalence of different components of social risk attitudes, their correlation with each other, and the differences between treatments. We end the paper with a discussion in Section 5 and a conclusion in Section 6.

2. Background

As an illustration, let us consider the canonical example of a society consisting of two individuals called Ann and Bob, adapted to the health domain. A social planner is asked to choose between the following four *social policies*, i.e., policies that determine the longevity (in expected life years) of Ann and Bob in two possible states of the world, as demonstrated in Fig. 1.

Thus, for instance, under social policy f Ann and Bob are expected to live for an additional 5 years, irrespective of the state of nature, while Ann is expected to live an additional 10 years and Bob faces imminent death under policy f'' . How should one evaluate these social policies? According to Harsanyi (1955), the policies should be evaluated by taking the sum of individual utilities. Assuming the social planner uses outcomes as utilities, the planner should be indifferent between the policies depicted in Fig. 1. Even though Harsanyi's (1955) approach is based on a set of normatively compelling assumptions (most notably Expected Utility and ex-ante Pareto efficiency), it ignores the fact that the policies differ in their degree of risk and inequality. For instance, Diamond (1967) noted that policy f'' gives both Bob and Ann a chance to live an additional 10 years, while policy f''' ensures that Ann lives an additional 10 years and Bob faces imminent death. Hence, according to Diamond (1967), a social planner should prefer policy f'' to f''' , because f'' is less unequal from an ex-ante perspective. A preference for policy f'' over f''' is confirmed empirically (e.g., Rohde and Rohde 2015), and is typically interpreted as constituting evidence for ex-ante inequality aversion. Note, however, that under policy f'' , outcomes of Ann and Bob are dependent on the state of nature, i.e., risky, while such risk is absent under policy f''' since Ann (Bob) is certain to live 10 (0) years under policy f''' . Hence, if society is sufficiently averse to individual members facing risk, policy f''' should be preferred to f'' , even though the latter is more unequal from an ex-ante perspective. This implies that previous measurements of attitudes toward ex-ante inequality based on the choice between policy f'' and f''' are potentially confounded by attitudes toward individual risk of the social planner.

Likewise, Broome (1991) noted that even though the expected total life years of policy f' and f'' are identical, and Bob and Ann have the same amount of expected life years from an ex-ante perspective, after the resolution of the uncertainty there will be no inequality under policy f' while there will be a significant amount of inequality in life years under policy f'' . Hence, Broome (1991) argued that f' should be preferred to f'' , because f'' is less equal from an ex-post perspective. This conjecture was confirmed empirically for health in a recent study by Abásolo and Tsuchiya (2020), who measured the prevalence of aversion toward ex-post inequality in a large sample of the Spanish general public. More specifically, Abásolo and Tsuchiya (2020) observe ex-post inequality aversion for monetary losses and health losses (i.e., people becoming seriously ill for a certain number of weeks). Note again that under policy f' the total amount of life years is dependent on the state of nature, while policy f'' is certain to yield a total of 10 additional life years. A social planner who is sufficiently averse to risk in total life years could therefore prefer f'' to f' , even though the former policy leads to inequality after the resolution of uncertainty. Moreover, interpreting the preference for policy f' to f'' as evidence for aversion to ex-post inequality might be incorrect if we acknowledge that the social planner might have a non-linear attitude toward collective risk. Rohde and Rohde (2015) indeed confirm that the majority of participants in a conventional laboratory experiment do not prefer f' to f'' because of aversion toward ex-post inequality (in fact, they display a *seeking* attitude toward ex-post inequality), but because they have a seeking attitude toward collective risk.

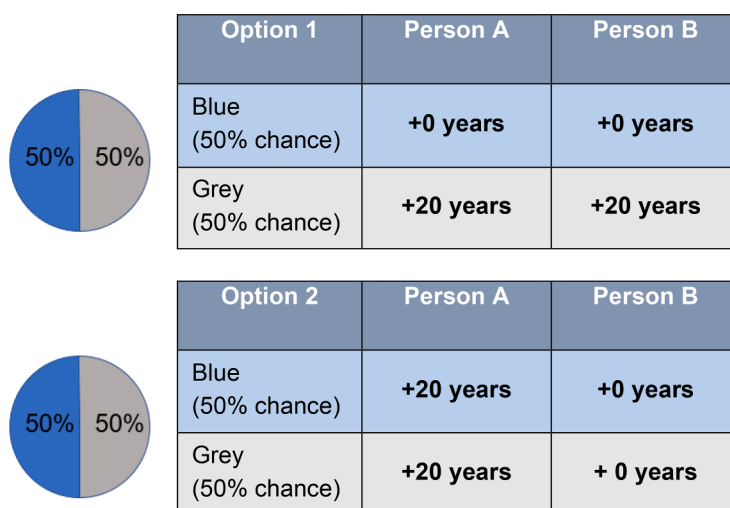


Fig. 2. A typical display.

Several papers have pointed out that traditional models of social welfare that assume that inequality aversion and risk aversion both derive from concavity of utility, may be too restrictive (e.g., [Blackorby and Donaldson, 1990](#); [Bleichrodt et al., 2004](#); [Cowell and Schokkaert, 2001](#)). As a result, several attempts have been made to incorporate different elements of social risk preferences in the welfare function. [Gajdos and Maurin \(2004\)](#) and [Ben-Porath et al. \(1997\)](#) assume that social planners evaluate policies by taking a convex combination of a term capturing ex-ante inequality and a term capturing ex-post inequality, implicitly assuming that the social planner is neutral toward individual and collective risk. [Bleichrodt et al. \(2004\)](#) propose a rank-dependent dual function where an equity weighting function complements a social utility function. In their model, inequality aversion can result both from concave social utility and from a convex equity weighting function. [Carlsson et al. \(2005\)](#) elicited risk aversion while holding the level of social inequality fixed in one experiment and elicited individual inequality aversion in a risk-free setting in another experiment. [Trautmann \(2010\)](#) proposes a two-stage model to incorporate fairness considerations in Harsanyi's utilitarianism. At the first stage, agents evaluate risky options using (egoistic) von Neumann–Morgenstern (vNM) utilities, which are then used as inputs in a Fehr-Schmidt fairness model to obtain risk-and fairness-inclusive utilities, implicitly assuming that the social planner is neutral toward collective risk. [Echazu and Nocetti \(2013\)](#) present a health-related social welfare function that disentangles risk and inequality preferences. However, they do not disentangle ex-ante and ex-post inequality preferences. [Samson et al. \(2018\)](#) advocate to perform economic evaluations of healthcare by using an ex-post perspective in a distributionally sensitive social welfare function of individual well-being levels.

Closest to the current paper is the paper by [Rohde and Rohde \(2015\)](#) who estimate a social welfare function with a separate parameter for each of the four components of social risk preferences based on choices of subjects between lotteries yielding monetary gains for other subjects in the laboratory. The modal choice pattern in their study is consistent with ex-ante inequality and individual risk aversion, and ex-post inequality and collective risk seeking. Our large and representative sample allows us to identify each component of social risk attitudes accurately, and test if the results of [Rohde and Rohde \(2015\)](#) on social risk preferences using students as subjects generalize to broader populations. More importantly, we test if social risk preferences are moderated by the type (health vs. wealth) and the domain (gains vs. losses) of the outcomes by treatment variation. Given that many important social risks (such as the risks of global warming and a pandemic) concern the allocation of losses rather than gains, measuring social risks in the loss domain is highly relevant for public policy.

3. Experimental design

3.1. Respondents & method

The artefactual field experiment was conducted at CentER Data with the LISS panel in April 2020. The LISS panel is a representative sample of the Dutch population, consisting of 9000 households that complete a questionnaire over the internet each month. In order to have a representative set of participants in every treatment, a stratified random sample was drawn from the entire panel. In total, 1600 respondents completed the experiment. On average, it took respondents 6 min to make all choices and they were paid approximately €2 for their participation.

3.2. Treatments & stimuli

Each respondent was asked to make 14 choices between two options yielding outcomes for two anonymous recipients, for

Table 2
Options HealthGains.

Choice	Option 1	Option 2
1	(0; 0); (20; 20)	(20, 0); (0, 20)
2	(5; 5); (15; 15)	(15, 5); (5, 15)
3	(20; 0); (0; 20)	(20, 0); (20, 0)
4	(15; 5); (5; 15)	(15, 5); (15, 5)
5	(20; 0); (20; 0)	(30, 0); (10, 0)
6	(20; 0); (20; 0)	(25, 0); (15, 0)
7	(5; 15); (5; 15)	(10, 15); (0, 15)
8	(5; 15); (5; 15)	(8, 15); (2, 15)
9	(10; 10); (10; 10)	(0, 0); (20, 20)
10	(10; 10); (10; 10)	(20, 0); (0, 20)
11	(10; 10); (10; 10)	(20, 0); (20, 0)
12	(10; 10); (10; 10)	(10, 20); (10, 0)
13	(0; 0); (20; 20)	(20, 0); (20, 0)
14	(5; 5); (15; 15)	(15, 5); (15, 5)

Notes: (a, b); (c, d) denotes a lottery yielding either a additional expected life years for person A and b additional expected life years for person B with probability 0.5, or c additional expected life years for person A and d additional life years for person B otherwise. Experimental instructions are detailed in [Appendix A](#).

Table 3
Percentage of choices consistent with each trait.

Trait	HealthGains (N = 393)	HealthLosses (N = 403)	WealthGains (N = 391)	WealthLosses (N = 413)
Risk Aversion ^a	80.92***	65.26***	87.21***	58.35***
Inequality Aversion	80.41***	78.41***	80.31***	76.76***
Risk vs. Inequality ^a	65.90***	74.19***	59.08***	71.43***

Notes:.

*** denotes significantly different from 50% at the 1% level (Signed-rank test).

^a significantly different between domains at the 1% level (Chi-square test).

convenience neutrally labelled “Person A” and “Person B.” Respondents were randomly allocated to four different treatments. In the *WealthGains* treatment, all options yielded positive amounts (in euros) for the two recipients; in the *WealthLosses* treatment, all choices yielded negative amounts. In the *HealthGains* treatment, all options yielded gains in life expectancy (in years) for the two recipients compared to the current life expectancy; in the *HealthLosses* treatment, options yielded reductions in life expectancy. In the health treatments, respondents were asked to assume that the two recipients were identical in all respects (gender, age, education, health status, etc.). In particular, respondents were explicitly informed that the recipients had the same life expectancy in the health treatments. This ensured that choices were not confounded by a potential preference for specific characteristics of one of the recipients (e.g., gender). Life years were transformed to outcomes in euros at the rate of 1 euro per day in good health, which is in line with the rate used by [Galizzi et al. \(2016\)](#).

All risks involved in the experiment were equiprobable (50/50) lotteries. For ease of interpretation of randomization, all risks were represented graphically by the spin of a coloured wheel; half the wheel was coloured blue, and the other half was coloured gray. [Fig. 2](#) (Choice 13 in the experiment) is an example of the display used in the HealthGains treatment.

To control for potential order effects and for a potential confound resulting from a preference for a particular position of the options on the screen these aspects were randomized. That is, the order of the 14 choices and the positions of the lotteries (top vs. bottom) were randomized between respondents. To control for efficiency motives, the expected outcomes were held constant across options and choices.

[Table 2](#) lists the specific choices in the HealthGains treatment (the choices of the other treatments can be found in [Appendix B](#)).

Even though choices in a spectator design do not have direct consequences for the spectator, the incentives that respondents faced were hypothetical in the sense that respondents did not have an incentive to report preferences truthfully (since their choices did not have real consequences for recipients). Hypothetical incentives were used to avoid different incentives schemes in different treatments since outcomes in terms of life expectancy cannot be implemented for real and implementing real monetary losses in experiments is problematic from an ethical perspective. An advantage of this approach is the fact that we were able to measure social risk attitudes for considerable sized monetary outcomes. Several previous papers suggest that individual preferences are often not found to be affected by the type of incentive scheme used (real vs. hypothetical) (e.g., [Abdellaoui et al., 2013](#); [Bardsley et al., 2009](#); [Cohen et al., 2020](#)).

Table 4
Demographic correlates risk aversion.

	(1) Health	(2)	(3) Wealth	(4)
Loss	-0.813*** (-4.90) [-0.155]	-0.953*** (-5.39) [-0.176]	-1.584*** (-8.73) [-0.284]	-1.609*** (-8.52) [-0.284]
Female	-0.185 (-1.13) [-0.036]	-0.048 (-0.27) [-0.009]	-0.064 (-0.38) [-0.012]	0.033 (0.18) [0.006]
Age (10y)	-0.011 (-0.24) [0.002]	-0.121* (-1.92) [-0.022]	-0.039 (-0.86) [-0.007]	-0.051 (-0.83) [-0.009]
Politics: Left	-	.057 (0.19) [0.010]	-	.702** (1.97) [1.23]
Politics: Conservative	-	.369 (1.05) [0.068]	-	-0.363 (-1.10) [-0.064]
Married	-	.386* (1.83) [0.071]	-	-0.036 (-0.17) [-0.006]
Divorced	-	.181 (0.58) [0.033]	-	.122 (0.38) [0.022]
# children	-	-0.080 (-0.86) [-0.015]	-	.024 (0.26) [0.004]
Log gross income	-	.072** (1.96) [0.013]	-	.055 (1.43) [0.010]
Home ownership	-	.480** (2.51) [0.089]	-	-0.021 (-0.10) [-0.004]
High education	-	.151 (0.83) [0.028]	-	.260 (1.41) [0.046]
Self-employed	-	-0.484 (-1.45) [0.089]	-	.410 (0.93) [0.073]
Constant	1.602** (5.43)	1.135*** (2.75)	2.155** (7.18)	1.654** (3.88)
N	797	759	805	751
Pseudo R ²	0.029	0.055	0.094	0.108

Notes: All regressions are Logit regressions, robust z-statistics in parenthesis, marginal effects in brackets (signs of the marginal effects are corroborated by unreported OLS regression analysis). "Loss" is an indicator variable taking value 1 if the respondent is in the loss treatment. "Political: Left" is an indicator variable taking value 1 if the respondent indicated to vote on a party on the left side of the political spectrum (Socialist-, Green-, Animal- or Labor party). "Politics: Conservative" is an indicator variable taking value 1 if the respondent indicated to vote on a conservative party (Christian Union, Christian Democratic Union, Calvinist party or Liberal party). "Female" is an indicator of being female. "Age (10y)" is the age of the respondent divided by 10. "Married" is an indicator variable taking the value one if the respondent is married. "Divorced" is an indicator variable taking the value one if the respondent is divorced. "High education" is an indicator variable taking the value one if the respondents has obtained a college degree or higher. "# children" is the number of children of the respondent. "Home ownership" is an indicator variable taking the value one if the respondent owns a house. "Self-employed" is an indicator variable taking the value one if the respondent is self-employed. */**/** denotes significance at the 10% / 5% / 1% level.

Table 5
Demographic correlates inequality aversion.

	(1) Health	(2)	(3) Wealth	(4)
Loss	-0.137 (-0.78) [-0.022]	-0.270 (-1.43) [-0.041]	-0.202 (-1.17) [-0.034]	-0.229 (-1.24) [-0.037]
Female	0.082 (0.47) [0.013]	0.234 (-1.43) [0.036]	-0.115 (-0.67) [-0.019]	.069 (0.37) [0.011]
Age (10y)	-0.070 (-1.41) [-0.012]	-0.214*** (-3.10) [-0.033]	-0.046 (-0.97) [-0.008]	-0.025 (-0.39) [-0.004]
Politics: Left	-	.527 (1.49) [-0.033]	-	.681* (1.72) [1.11]
Politics: Conservative	-	.539 (1.40) [0.083]	-	-0.810*** (-2.61) [-0.132]
Married	-	.810*** (3.47) [1.25]	-	-0.111 (-0.51) [-0.018]
Divorced	-	.466 (1.35) [0.072]	-	.069 (0.20) [0.011]
# children	-	-0.021 (-0.20) [-0.003]	-	.094 (0.92) [0.015]
Log gross income	-	.074* (1.79) [0.011]	-	.055 (1.44) [0.009]
Home ownership	-	.119 (0.55) [0.018]	-	.000 (0.00) [0.00]
High education	-	.680*** (3.18) [1.04]	-	.603*** (2.95) [0.098]
Self employed	-	-0.990*** (-2.81) [-0.152]	-	.632 (1.17) [1.03]
Constant	1.749*** (5.50)	1.228*** (2.75)	1.703*** (7.72)	.912** (2.14)
N	796	758	805	751
Pseudo R ²	0.035	0.057	0.003	0.038

Notes: See Table 4. */**/** denotes significance at the 10% / 5% / 1% level.

4. Results

4.1. Non-parametric analysis

4.1.1. Risk preferences

As Table 2 shows, the second option of choice 9 either yields an additional 20 life years for person A and B or it yields no additional life years for both persons. Since both recipients face a health risk and the total gain in life years is uncertain, the second option exhibits both types of risk, but no (ex-ante and ex-post) inequality. On the other hand, the first option in choice 9 is completely risk- and inequality-free, because it yields a certain 10 additional life years for both persons. Hence, option 9 identifies pure attitude toward risk in a parameter-free way: a preference (dislike) for option 1 over option 2 directly classifies respondents as being risk averse (seeking). The second row of Table 3 presents the percentage of choices consistent with risk aversion across treatments. As can be seen in the table, risk aversion is the predominant pattern in each treatment. We observe a strong moderating effect of the domain of the outcomes: risk aversion is significantly less pronounced in the loss domain for both health and wealth (Chi-square test $p < 0.01$), for

Table 6
Demographic correlates tradeoff risk vs. inequality.

	(1) Health	(2)	(3) Wealth	(4)
Loss	.394** (2.52) [.082]	.357** (2.17) [.071]	.569*** (3.78) [.126]	.616*** (3.85) [.131]
Female	0.127 (0.81) [.026]	0.238 (1.42) [.048]	.049 (0.33) [.011]	.166 (1.01) [.036]
Age (10y)	-0.042 (-0.95) [-0.009]	-0.059 (-0.99) [-0.012]	-0.069 (-1.67) [-0.015]	-0.063 (-1.11) [-0.013]
Politics: Left	-	.549 (1.73) [.110]	-	-0.073 (0.25) [.015]
Politics: Conservative	-	.156 (0.51) [.031]	-	-0.775 (-2.51) [-0.165]
Married	-	-0.012 (-0.06) [-0.002]	-	-0.177 (-0.89)
Divorced	-	-0.442 (-1.46) [-0.088]	-	-0.059 (-0.20)
# children	-	-0.036 (-0.40) [-0.007]	-	-0.002 (-0.02)
Log gross income	-	.049 (1.39) [.009]	-	.037 (1.07)
Home ownership	-	.093 (0.49) [.019]	-	-0.289 (-1.52)
High education	-	.486*** (2.72) [.097]	-	.568*** (3.27)
Self employed	-	.230 (0.61) [.046]	-	.099 (0.26)
Constant	.812*** (2.96)	.311** (0.78)	.693*** (2.73)	.476 (1.20)
N	797	759	805	751
Pseudo R ²	0.009	0.030	0.016	0.044

Notes: See Table 4. */**/** denotes significance at the 10% / 5% / 1% level.

example, for wealth losses, 41.65% of individuals exhibited risk seeking. Table 3 also show that all percentages of choices are different from 50%, which would have indicated pure random or inattentive choice across choice situations.

We now consider the influences of demographic characteristics on risk preferences.¹ Table 4 below presents the results of robust Logit regressions using the choice for the risk averse option as the dependent variable. The estimation results corroborate domain-dependence of risk attitudes: the loss domain reduces the probability of selecting the risk averse option roughly 18pp. for health, and 28pp. for wealth, controlling for background characteristics of respondents. We observe that income is positively related to aversion to risk in the health domain and that respondents on the left side of the political spectrum are more averse to wealth risks, which corroborates the findings of Johansson-Stenman et al. (2002).

4.1.2. Inequality preferences

Choice 11 directly identifies attitude toward inequality in a parameter-free way. In this choice, the first option is risk- and inequality-free. The second choice is also (individual and collective) risk free, but it exhibits inequality from an ex-ante- (recipient A is expected to gain 20 life years, while recipient B is expected not to gain any life years) and an ex-post perspective (recipient A is sure to live longer than recipient B after the resolution of uncertainty). The second row of Table 3 shows that respondents are consistently averse to inequality for health and wealth, confirming previous findings in the literature (e.g. Hurley et al., 2020). Interestingly, the moderating role of the domain of outcomes for risk preferences does not extend to inequality preferences. This is confirmed by a series of Logit regressions using the choice for the inequality averse option as the dependent variable. Table 5 shows the estimation results. As can be seen in the table, we observe a robust effect of educational attainment on attitude to inequality. Highly educated respondents are more likely to choose the inequality averse option, irrespective of whether the outcomes are monetary or in terms of longevity. This corroborates the result of a recent study by Asaria et al. (2021), who measure the prevalence of health and income inequality aversion in a large sample of British, German and Italian respondents. More conservative respondents are less averse to wealth inequality, while older respondents are less averse to social inequality in life years.

4.1.3. Trade-off between risk- and inequality aversion

The final row of Table 3 presents the choice percentages in choice 13. This choice is particularly interesting: the first option exhibits maximum risk from both an individual and collective perspective (absence of inequality) while the second option exhibits maximum inequality from both an ex-ante and ex-post perspective (absence of risk). Thus, the choice identifies whether the respondents would rather face maximum risk or maximum inequality. As can be seen in the Table, the majority of respondents prefers option 1 over option 2, suggesting that inequality aversion dominates risk aversion: respondents rather face risk than inequality, for health and wealth. At first glance, this effect is moderated by the sign of outcomes; in the loss domain, the preference for option 1 is more pronounced. This is corroborated by the results of a robust Logit regression using the choice for option 1 as the dependent variable, as shown in Table 6.

We indeed observe a strong moderating effect of the domain: the inclination to prefer risk over inequality is stronger for losses for both wealth and health. This is in line with our previous observation that respondents are less averse towards risk – but are equally averse to inequality – in the loss domain compared to the domain of gains (Table 3). Hence, since facing risk hurts more for gains than for losses, a higher fraction of respondents prefers the option with maximum risk over the option with maximum inequality for losses.

¹ Descriptive statistics on the individual characteristics reported in Table 4 are detailed in Appendix C.

Table 7
Measures of dispersion.

Individual risk (<i>ind</i>)	Collective risk (<i>coll</i>)	Ex-ante inequality (<i>ante</i>)	Ex-post inequality (<i>post</i>)
$\frac{1}{n} \sum_{i=1}^n G(X_i)$	$G(\sum_{i=1}^n X_i)$	$G(\sum_{j=1}^m p_j x_i^j)$	$\sum_{j=1}^m p_j G(X^j)$

Notes: x_i^j denotes the outcome of individual $i = 1, \dots, n$ in society $j = 1, \dots, m$, p_j denotes the probability of society j to be implemented, $X_i = (p_1 : x_i^1, \dots, p_m : x_i^m)$ denotes an ex-ante allocation for individual i and $X^j = (x_1^j, \dots, x_n^j)$ denotes an ex-post allocation in society j .

Table 8
Mixed Logit model, mean parameters.

	HealthGains	HealthLosses	WealthGains	WealthLosses
Individual risk (α)	-2.589*** (0.492)	-0.097 (0.368)	-4.042*** (0.613)	-0.183 (0.341)
Collective risk (β)	-2.661*** (0.457)	-1.891*** (0.340)	-2.386*** (0.501)	-1.294*** (0.304)
Ex-ante inequality (γ)	-3.564*** (0.518)	-1.850*** (0.402)	-5.205*** (0.641)	-1.969*** (0.369)
Ex-post inequality (δ)	-3.955*** (0.475)	-3.099*** (0.353)	-3.318*** (0.514)	-2.289*** (0.315)
Log Likelihood	-2710.457	-3168.239	-2566.734	-3355.552
Num. obs.	5502	5642	5474	5782
LR test no random effects	1099.287	738.191	1038.610	688.018
LR test uncorrelated effects	274.499	135.209	187.644	124.758

Notes: All regressions are random parameter Logit regressions for the random utility model, standard errors in parenthesis. Independent variables are Gini coefficients associated with each option. Negative coefficients indicate aversion to risk/inequality, positive coefficients risk/inequality seeking. */**/** denotes significance at the 10% / 5% / 1% level.

4.2. Parametric analysis

The results presented in the previous section suggest that respondents are universally averse to risk and inequality for health and wealth. However, the non-parametric analysis does not distinguish between the different components of risk- and inequality- preferences. For example, it could very well be that respondents are risk seeking collectively (as found by Rohde and Rohde 2015), but dislike individual risk to such an extent that individual risk aversion dominates collective risk seekingness, resulting in aversion toward risk in the aggregate. A further decomposition of risk attitude into an individual component and a collective component, and inequality attitude into an ex-ante component and an ex-post component, requires a parametric analysis.

To model and quantify the different components of social risk preferences, we follow Rohde and Rohde (2015) who use Gini-coefficients as a measure of dispersion.² The measure of individual risk, denoted *ind*, is the average value (over individuals) of Gini coefficients applied to individual allocations. As a measure of collective risk, denoted *coll*, we computed the Gini coefficient applied to the allocations of ex-ante collective allocation. As a measure of ex-ante inequality, we computed the Gini coefficient applied to the allocation of individual expected values. Last, the measure of ex-post inequality, denoted *post*, is the expected Gini coefficient of ex-post allocations. Table 7 summarizes the measures.

Moreover, following Rohde and Rohde (2015), we estimate a random utility model on all 14 choices in which the deterministic component of utility is assumed to be a function of individual risk (*ind*), collective risk (*col*), ex-ante inequality (*ante*) and ex-post inequality (*post*). Formally, for participant s , the utility of option k in task t is given by:

$$V_{s,k,t} = \alpha_s \ln(1 + ind_{k,t}) + \beta_s \ln(1 + coll_{k,t}) + \gamma_s \ln(1 + ante_{k,t}) + \delta_s \ln(1 + post_{k,t}) + \epsilon_{s,k,t}. \tag{1}$$

In this specification, α_s , β_s , δ_s and γ_s capture attitude toward individual risk, collective risk, ex-ante inequality, and ex-post inequality, for participant s , respectively. $\epsilon_{s,k,t}$ denotes the error term for option k in task t , for participant s . Following Rohde and Rohde (2015), the specification adds a constant 1 to each variable to ensure that if a variable takes on a zero value, it has a zero effect on the evaluation. We assume $\epsilon_{s,k,t}$ follows a Gumbell distribution and estimate the random utility model as a random parameter (mixed) Logit model where individual parameters α_s , β_s , δ_s and γ_s are treated as random variables. We assume the parameters follow a multivariate normal distribution with means α , β , δ and γ and (full) covariance matrix Σ , and use maximum simulated likelihood to estimate the model. We further assume a panel structure in order to account for interdependencies of choices within subjects.³

² For $X^j = (x_1^j, \dots, x_n^j)$ a rank-ordered allocation $x_1^j \leq x_2^j \leq \dots \leq x_n^j$ across all members $i = 1, 2, \dots, n$ of society j , the Gini coefficient for the allocation X^j is defined as: $G(X^j) = \frac{n}{n-1} \times \left(\frac{2 \sum_{i=1}^n i \times x_i^j}{n \sum_{i=1}^n x_i^j} - \frac{n+1}{n} \right)$.

³ The model was estimated with the mlogit package in R, based on 500 Halton draws for each participant.



Fig. 3. Distributions of individual random effects.

Table 9
Mixed Logit model, correlation matrix of random parameters.

	<i>HealthGains</i>	<i>HealthLosses</i>	<i>WealthGains</i>	<i>WealthLosses</i>
σ_{α}	2.013*** (0.636)	1.916*** (0.590)	4.176*** (0.805)	2.213*** (0.536)
σ_{β}	3.716*** (0.428)	1.951*** (0.426)	2.972*** (0.323)	1.768*** (0.406)
σ_{δ}	4.105*** (0.390)	3.550*** (0.453)	6.452*** (0.658)	3.031*** (0.360)
σ_{γ}	5.263*** (0.401)	3.369*** (0.341)	4.343*** (0.323)	2.421*** (0.339)
$\rho_{\alpha,\beta}$	0.608*** (0.109)	0.713*** (0.197)	-0.162 (0.529)	0.841*** (0.185)
$\rho_{\alpha,\delta}$	0.379** (0.150)	0.588*** (0.119)	0.662*** (0.069)	0.488*** (0.106)
$\rho_{\alpha,\gamma}$	0.932*** (0.058)	0.385* (0.205)	0.394 (0.362)	0.798*** (0.095)
$\rho_{\beta,\delta}$	0.430*** (0.145)	0.368* (0.195)	-0.035 (0.348)	0.617*** (0.145)
$\rho_{\beta,\gamma}$	0.897*** (0.032)	0.730*** (0.085)	0.767*** (0.053)	0.477*** (0.113)
$\rho_{\delta,\gamma}$	0.777*** (0.082)	0.334* (0.190)	0.466* (0.243)	0.634*** (0.126)

Notes: All regressions are random parameter Logit regressions for the random utility model, standard errors in parenthesis, computed with the Delta method. */**/** denotes significance at the 10% / 5% / 1% level.

4.2.1. Main effects

Table 8 shows the estimation results for the mean parameter in each treatment. Table 8 also shows the results of Lagrange multiplier tests for the specification of the random parameter model against two nested models: a model with no individual-level random effects and a model with random but uncorrelated effects. All Lagrange multiplier tests show the better fit of a model with correlated random effects.

As can be seen in Table 8, the mean preference was aversion for all traits in the gain domain, suggesting that all motives played a significant role in the gain domain. In particular, we observe aversion toward both types of risk (individual and collective) and both types of inequality (ex-post and ex-ante), for monetary outcomes and for outcomes in longevity. For losses, the pattern is somewhat different. We again observe aversion toward both types of inequality and collective risk, but respondents appear to be neutral toward individual risk. Table 8 also shows that inequality aversion is weaker in the loss domain than in the gain domain, both for health and for wealth. The comparison between attitudes towards ex-post inequality and ex-ante inequality in the loss domain shows aversion to ex-post inequality is stronger than aversion to ex-ante inequality, but the (two-sided) difference is only marginally significant for *HealthLosses* (Wald tests, $p = 0.08$ for longevity and $p = 0.63$ for wealth).

4.2.2. Individual heterogeneity

Fig. 3 shows the distribution of individual random effects for each parameter α , β , δ , γ . Table 9 provides further information on the estimated parameters for the correlation matrix of the random effects.

As illustrated in Fig. 3, the results show a rather large individual heterogeneity for attitudes towards ex-ante and ex-post inequality, especially when compared to the heterogeneity in individual risk attitudes. Visual inspection of Fig. 3 shows heterogeneity of attitudes for collective risk and attitudes towards inequalities seem to be stronger for gains than for losses. We found the standard deviation of attitudes for collective risk to be significantly higher for gains than for losses for health (z-test, $p < 0.01$) but not for wealth (z-test, $p = 0.2$).⁴ For attitudes towards ex-ante inequality, we found an opposite pattern with more heterogeneity for gains than for losses for wealth (z-test, $p < 0.01$) but not for health (z-test, $p = 0.31$). Last, we found a larger standard deviation in the gain domain than in the loss domain for ex-post inequality for both domains (z-test, $p < 0.01$ in both cases).

Table 9 also shows positive correlations between risk attitudes (individual and collective) and attitudes towards ex-ante inequalities. Results show that *WealthGains* were distinct from other treatments: neither correlations between risk attitudes (α and β), nor correlations between collective risk attitudes and attitudes towards ex-ante inequalities were significantly different from zero.

4.2.3. Individual characteristics

To further control for individual heterogeneity, we included individual characteristics as fixed effects in the estimation of the random utility model. Detailed results are reported in Appendix D. The results indicate no general gender effects. Controlling for age, women were less averse to collective risk and ex-post inequality than men for monetary gains. The latter is consistent with the results in Rohde and Rohde (2015). However, this result does no longer hold when we control for other characteristics. Among demographic characteristics, age was the most significant: older respondents were more averse to individual risk for monetary losses and marginally more tolerant to individual risk for monetary and health gains. We also found evidence for increased tolerance for collective risk (health gains and monetary losses) and ex-ante inequality (health gains and losses, wealth gains) and ex-post inequality (monetary losses). Results regarding other individual characteristics are more dispersed and only few patterns emerge, for example, respondents on the left side of the political spectrum were more averse to both collective risk and ex-post inequality for longevity gains. In accordance with the non-parametric analysis, we again observe an effect of educational attainment on attitudes toward inequality. The parametric results show more aversion to ex-ante inequality for reductions in longevity and improvements in wealth.

5. Discussion

5.1. Comparison of findings with previous results

Our non-parametric analysis shows that the majority of respondents are averse to risk and inequality; more than 70% of respondents prefer to avoid risk and inequality in the domain of gains, confirming previous results based on data obtained in artefactual field settings (e.g., Abásolo and Tsuchiya, 2020; Hurley et al., 2020). The non-parametric analysis also reveals that inequality aversion dominates risk aversion: respondents rather face risk than inequality, for health and wealth, and for both domains (even though this tendency is less pronounced for losses). For the outcomes framed in terms of losses in income, this replicates the results of Abásolo and Tsuchiya (2020) who observe the same pattern in a representative (albeit highly educated) sample of the Spanish population. For health outcomes, our findings replicate those of Keller and Sarin (1988) for outcomes in terms of the number of lives lost. However, Abásolo and Tsuchiya (2020) find the opposite for losses in the health domain: in their sample, (ex-post) inequality aversion is weaker than (collective) risk aversion. A possible explanation for this difference in findings could be that Abásolo and Tsuchiya (2020) measure preferences by eliciting equivalence instead of through direct choice and the health outcomes are framed in terms of weeks of sickness rather than in terms of losses in longevity. Moreover, Abásolo and Tsuchiya (2020) use options like those in choice 1 of the experiment to measure aversion toward inequality and risk. In our more general framework, choices of this type amount to making a

⁴ We applied a z-test to the standard deviation of the marginal distributions.

Table B-1
Options HealthLosses, WealthGains and Wealthlosses.

Choice	HealthLosses		WealthGains		WealthLosses	
	Option 1	Option 2	Option 1	Option 2	Option 1	Option 2
1	(0; 0); (-20; -20)	(-20, 0); (0, -20)	(0; 0); (10,000; 10,000)	(10,000, 0); (0, 10,000)	(0; 0); (-10,000; -10,000)	(-10,000, 0); (0, -10,000)
2	(-5; -5); (-15; -15)	(-15, -5); (-5, -15)	(2500; 2500); (7500; 7500)	(7500, 2500); (2500, 7500)	(-2500; -2500); (-7500; -7500)	(-7500, -2500); (-2500, -7500)
3	(-20; 0); (0; -20)	(-20, 0); (-20, 0)	(10,000; 0); (0; 10,000)	(10,000, 0); (10,000, 0)	(-10,000; 0); (0; -10,000)	(-10,000, 0); (-10,000, 0)
4	(-15; -5); (-5; -15)	(-15, -5); (-15, -5)	(7500; 2500); (2500; 7500)	(7500, 2500); (7500, 2500)	(-7500; -2500); (-2500; -7500)	(-7500, -2500); (-7500, -2500)
5	(-20; 0); (-20; 0)	(-30, 0); (-10, 0)	(10,000; 0); (10,000; 0)	(15,000, 0); (5000, 0)	(-10,000; 0); (-10,000; 0)	(-15,000, 0); (-5000, 0)
6	(-20; 0); (-20; 0)	(-25, 0); (-15, 0)	(10,000; 0); (10,000; 0)	(12,500, 0); (7500, 0)	(-10,000; 0); (-10,000; 0)	(-12,500, 0); (-7500, 0)
7	(-5; -15); (-5; -15)	(-10, -15); (0, -15)	(2500; 7500); (2500; 7500)	(5000, 7500); (0, 7500)	(-2500; -7500); (-2500; -7500)	(-5000, -7500); (0, -7500)
8	(-5; -15); (-5; -15)	(-8, -15); (-2, -15)	(2500; 7500); (2500; 7500)	(4000, 7500); (1000, 7500)	(-2500; -7500); (-2500; -7500)	(-4000, -7500); (-1000, -7500)
9	(-10; -10); (-10; -10)	(0, 0); (-20, -20)	(5000; 5000); (5000; 5000)	(0, 0); (10,000, 10,000)	(-5000; -5000); (-5000; -5000)	(0, 0); (-10,000, -10,000)
10	(-10; -10); (-10; -10)	(-20, 0); (0, -20)	(5000; 5000); (5000; 5000)	(10,000, 0); (0, 10,000)	(-5000; -5000); (-5000; -5000)	(-10,000, 0); (0, -10,000)
11	(-10; -10); (-10; -10)	(-20, 0); (-20, 0)	(5000; 5000); (5000; 5000)	(10,000, 0); (10,000, 0)	(-5000; -5000); (-5000; -5000)	(-10,000, 0); (-10,000, 0)
12	(-10; -10); (-10; -10)	(-10, -20); (-10, 0)	(5000; 5000); (5000; 5000)	(5000, 10,000); (5000, 0)	(-5000; -5000); (-5000; -5000)	(-5000, -10,000); (-5000, 0)
13	(0; 0); (-20; -20)	(-20, 0); (-20, 0)	(0; 0); (10,000; 10,000)	(10,000, 0); (10,000, 0)	(0; 0); (-10,000; -10,000)	(-10,000, 0); (-10,000, 0)
14	(-5; -5); (-15; -15)	(-15, -5); (-15, -5)	(2500; 2500); (7500; 7500)	(7500, 2500); (7500, 2500)	(-2500; -2500); (-7500; -7500)	(-7500, -2500); (-7500, -2500)

Notes: (a, b); (c, d) denotes a lottery yielding either a additional expected life years for person A and b additional expected life years for person B with probability 0.5, or c additional expected life years for person A and d additional life years for person B otherwise.

choice between facing *collective* risk or facing *ex-post* inequality, keeping the degree of *individual* risk and *ex-ante* inequality constant. Hence, a potential explanation for the fact that our findings differ from those reported by [Abásolo and Tsuchiya \(2020\)](#) is that the observed traits interact. For example, if collective risk aversion is weaker when the respondent also faces individual risk aversion, the resulting pattern would manifest itself. Further research could address the potential interaction of the different components of risk- and inequality preferences.

Our parametric decomposition of aversion toward risk and inequality aversion reveals that respondents are averse to each component of social risk for increases in wealth and longevity. That is, in the domain of gains, the mean preference is averseness toward individual and collective risk and ex-post and ex-ante inequality aversion. Aversion towards ex-ante inequality and individual risk for monetary outcomes replicates the findings of [Rohde and Rohde \(2015\)](#), but aversion toward collective risk and ex-post inequality contradicts their results. Potential explanations for these differences in findings are differences in the experimental design (e.g., in Rohde and Rohde’s experiment, social planners allocate risks over ten other recipients instead of over two) and differences in the composition of the sample (university students vs. a general population sample). Previous work comparing choice behavior of students and respondents in the LISS panel has documented differences in behavioral traits such as individual risk preferences (e.g., [Noussair et al., 2014](#)). Replicating the current study on a student sample to test whether social risk attitudes of students indeed differ from the general public would be a promising avenue of research.

[Rohde and Rohde \(2015\)](#) show that the absence of control for attitudes to collective risk can bias the estimation of ex-post inequality aversion in a risky context. More specifically, they show that collective risk aversion results in aversion to ex-post inequality. Because their data exhibit collective risk seeking, [Rohde and Rohde \(2015\)](#) predict estimated aversion to ex-post inequality to increase if neutrality to collective risk is assumed. Results from [Table 8](#) show both ex-post inequality aversion and collective risk aversion. As a consequence, we predict estimated ex-post inequality aversion to decrease when neutrality toward collective risk is assumed. Estimations with only one motive at a time support this hypothesis (see [Appendix E](#) for detailed results): for all four treatments (gains/losses, health/monetary outcomes), estimated aversion to ex-post inequality aversion was reduced by at least a factor 1.3 when the impact of collective risk was not accounted for. Our results thus suggest that many previous measurements of ex-post inequality aversion based on the choice between options like f' and f'' depicted in [Fig. 1](#) are biased downwards. Collective risk aversion makes the option without ex-post inequality (f') less attractive, because it has collective risk, thereby reducing the percentage of respondents preferring it. Likewise, the fact that we observe aversion towards individual risk in our large-scale sample suggests that previous studies have underestimated the degree of aversion toward ex-ante inequality.

Table C-1
descriptive statistics on individual characteristics and statistical differences between subsamples.

Variable		Subsamples HealthGains	HealthLosses	WealthGains	WealthLosses	Statistical test Chi-squared test	Kruskal-Wallis rank sum test
Gender	man	194 (25.19%)	184 (23.90%)	186 (24.16%)	206 (26.75%)	p value: 0.619	p value: 0.194
	woman	199 (23.98%)	219 (26.39%)	205 (24.70%)	207 (24.94%)		
Age	median [IQR]	56.0 [39.0;67.0]	53.0 [37.5;66.0]	52.0 [35.5;66.0]	56.0 [39.0;68.0]	p value: 0.352	
	mean (sd)	53.0 (17.9)	51.4 (17.7)	50.9 (18.1)	52.8 (18.6)		
Political orientation	Neutral	202 (22.88%)	222 (25.14%)	212 (24.01%)	247 (27.97%)	p value: 0.402	
	Left	90 (26.09%)	84 (24.35%)	87 (25.22%)	84 (24.35%)		
	Conservative	101 (27.15%)	97 (26.08%)	92 (24.73%)	82 (22.04%)		
Marital status	Other	151 (25.72%)	144 (24.53%)	141 (24.02%)	151 (25.72%)	p value: 0.595	
	Married	199 (23.30%)	230 (26.93%)	207 (24.24%)	218 (25.53%)		
	Divorced	43 (27.04%)	29 (18.24%)	43 (27.04%)	44 (27.67%)		
Gross income	median [IQR]	2185.6 [1131.6;3457.1]	2300.0 [1154.6;3446.1]	2096.0 [1227.0;3150.0]	2287.8 [1154.1;3451.1]	p value: 0.616	
	mean (sd)	2405.0 (1802.4)	2640.9 (2399.3)	2612.2 (3396.4)	2513.9 (2013.6)		
Home ownership	Other	119 (25.93%)	106 (23.09%)	116 (25.27%)	118 (25.71%)	p value: 0.593	
	Owner	274 (24.01%)	297 (26.03%)	275 (24.10%)	295 (25.85%)		
Education	secondary or less	235 (24.40%)	239 (24.82%)	229 (23.78%)	260 (27.00%)	p value: 0.740	
	college	158 (24.80%)	164 (25.75%)	162 (25.43%)	153 (24.02%)		
Self-employment	Other	373 (24.64%)	377 (24.90%)	372 (24.57%)	392 (25.89%)	p value: 0.740	
	Self employed	20 (23.26%)	26 (30.23%)	19 (22.09%)	21 (24.42%)		

Notes: the last column shows the p-value of the relevant test for statistical differences. Percentages in parentheses correspond to the proportion of each characteristic in the whole sample, e.g. 23.26% of self-employed in HealthGains is the proportion of self-employed in HealthGains in the total sample of self-employed.

Table d-1

Parameter estimates, random parameter Logit model with demographic characteristics and individual characteristics.

	HealthGains		HealthLosses		WealthGains		WealthLosses		
	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)	
Female x	α	-4.607*** (1.312)	-4.002 (5.131)	-1.020 (1.015)	5.549 (3.818)	-5.529*** (1.340)	-4.156 (6.019)	0.940 (0.990)	0.570 (3.899)
	β	-5.006*** (1.138)	-0.797 (4.412)	-0.057 (0.893)	-3.386 (3.336)	-3.034*** (1.087)	-1.410 (5.129)	-2.207** (0.869)	-2.418 (3.467)
	δ	-8.551*** (1.394)	-7.781 (5.360)	-4.860*** (1.092)	0.383 (4.009)	-7.884*** (1.397)	-9.460 (6.317)	-2.619** (1.057)	-3.609 (4.150)
	γ	-5.574*** (1.157)	-1.200 (4.464)	-0.366 (0.898)	0.001 (3.372)	-3.520*** (1.105)	1.058 (5.210)	-3.514*** (0.885)	-1.056 (3.495)
	α	-0.457 (0.777)	-0.935 (0.939)	-0.371 (0.635)	-1.227* (0.743)	-1.082 (0.815)	-0.579 (1.043)	0.792 (0.607)	0.325 (0.734)
Age (10y) x	β	0.599 (0.679)	0.482 (0.843)	0.152 (0.564)	0.338 (0.655)	1.624** (0.688)	1.156 (0.914)	-0.730 (0.529)	-0.886 (0.649)
	δ	-0.403 (0.807)	-1.012 (0.970)	-0.376 (0.671)	-1.193 (0.783)	-1.141 (0.845)	-0.679 (1.090)	0.523 (0.635)	0.097 (0.777)
	γ	0.510 (0.686)	0.228 (0.851)	-0.536 (0.569)	-1.055 (0.663)	1.497** (0.696)	0.940 (0.931)	-0.416 (0.533)	-1.016 (0.657)
	α	0.397* (0.206)	0.788** (0.309)	0.238 (0.170)	0.084 (0.267)	0.406* (0.208)	0.610* (0.328)	-0.279* (0.157)	-0.610*** (0.230)
	β	0.395** (0.179)	0.531* (0.277)	-0.393*** (0.151)	-0.085 (0.239)	-0.009 (0.174)	0.052 (0.285)	0.235* (0.137)	0.418** (0.205)
Politics, Left x	δ	0.944*** (0.218)	1.342*** (0.321)	0.648*** (0.181)	0.491* (0.282)	0.634*** (0.215)	0.926*** (0.342)	0.080 (0.166)	-0.135 (0.244)
	γ	0.268 (0.182)	0.410 (0.279)	-0.499*** (0.152)	-0.133 (0.243)	-0.082 (0.175)	-0.279 (0.290)	0.265* (0.138)	0.550*** (0.208)
	α		1.257 (1.145)		0.867 (0.973)		-0.077 (1.274)		0.229 (0.883)
	β		-2.714*** (1.040)		-0.699 (0.894)		-0.968 (1.120)		0.116 (0.769)
	δ		1.819 (1.183)		-0.790 (1.035)		-0.716 (1.330)		-0.151 (0.927)
Politics, Conservative x	γ		-2.391** (1.045)		-1.283 (0.911)		-0.116 (1.142)		-0.440 (0.770)
	α		0.706 (1.115)		1.444* (0.872)		0.327 (1.230)		0.004 (0.911)
	β		-1.524 (0.996)		-0.460 (0.769)		-0.238 (1.065)		0.278 (0.798)
	δ		0.537 (1.153)		0.624 (0.920)		-0.480 (1.279)		-0.737 (0.949)
	γ		-0.944 (1.006)		-0.953 (0.778)		0.385 (1.086)		-0.017 (0.807)
Married x	α		-1.290 (1.064)		-0.965 (0.859)		-0.156 (1.154)		1.433* (0.802)
	β		-0.441 (0.964)		-0.549 (0.761)		-0.622 (0.998)		-1.176* (0.708)
	δ		-1.713 (1.098)		-0.927 (0.905)		0.083 (1.201)		1.574* (0.845)
	γ		-1.270 (0.973)		-0.652 (0.771)		0.421 (1.012)		-1.164 (0.714)
	α		-4.976*** (1.479)		1.347 (1.619)		-0.855 (1.749)		1.287 (1.197)
Divorced x	β		3.597*** (1.311)		-0.951 (1.474)		-1.614 (1.544)		-0.352 (1.067)
	δ		-4.744*** (1.541)		0.996 (1.717)		-0.279 (1.817)		0.437 (1.261)
	γ		3.369** (1.332)		-0.802 (1.517)		-0.533 (1.564)		-0.487 (1.085)
	α		0.605 (0.503)		0.032 (0.390)		0.165 (0.530)		-0.290 (0.387)
	β		-0.154 (0.462)		-0.187 (0.339)		0.256 (0.451)		0.072 (0.349)
# children x	δ		0.504 (0.514)		-0.087 (0.419)		0.479 (0.555)		-0.716* (0.413)
	γ		0.113 (0.466)		-0.449 (0.341)		0.302 (0.462)		0.297 (0.355)
	α		-0.208 (0.672)		-0.619 (0.482)		0.034 (0.781)		0.315 (0.496)
	β		-0.552		0.258		-0.284		-0.132

(continued on next page)

Table d-1 (continued)

	HealthGains		HealthLosses		WealthGains		WealthLosses		
	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)	
		(0.583)		(0.422)		(0.663)		(0.441)	
	δ	-0.277		-0.337		0.392		0.332	
		(0.699)		(0.504)		(0.817)		(0.524)	
	γ	-0.483		-0.133		-0.598		-0.503	
		(0.590)		(0.428)		(0.678)		(0.445)	
Home ownership x	α	-0.152		-0.506		-2.139*		-1.234	
		(1.054)		(0.838)		(1.099)		(0.792)	
	β	0.108		-0.106		1.585*		1.334*	
		(0.929)		(0.737)		(0.956)		(0.706)	
	δ	1.168		-0.067		-1.404		-0.870	
		(1.095)		(0.882)		(1.145)		(0.829)	
	γ	-0.332		-0.696		1.813*		1.305*	
		(0.938)		(0.746)		(0.978)		(0.711)	
High education x	α	-0.433		-0.879		-1.837		0.772	
		(1.049)		(0.812)		(1.209)		(0.766)	
	β	-1.221		1.098		-1.084		-0.803	
		(0.936)		(0.731)		(1.024)		(0.669)	
	δ	-1.513		-2.333***		-3.565***		0.379	
		(1.086)		(0.864)		(1.257)		(0.804)	
	γ	-1.803*		1.317*		-1.812*		-0.861	
		(0.946)		(0.747)		(1.044)		(0.674)	
Self- employed x	α	0.906		0.640		2.481		-1.029	
		(1.970)		(1.535)		(2.444)		(1.737)	
	β	2.044		0.036		-3.055		0.139	
		(1.776)		(1.412)		(2.293)		(1.613)	
	δ	0.442		0.685		2.394		-0.508	
		(2.024)		(1.610)		(2.613)		(1.841)	
	γ	1.656		0.839		-3.985*		-1.008	
		(1.819)		(1.444)		(2.417)		(1.639)	
Covariance matrix	σ_α	2.128***	1.420**	1.691***	1.658***	3.236***	2.061***	2.122***	1.921***
		(0.685)	(0.717)	(0.533)	(0.635)	(0.681)	(0.736)	(0.542)	(0.614)
	σ_β	2.159***	1.861***	1.690***	1.713***	0.664	0.668	1.663***	1.873***
		(0.584)	(0.629)	(0.460)	(0.566)	(0.544)	(0.611)	(0.469)	(0.540)
	σ_δ	2.747***	3.059***	0.959***	0.325	2.010***	2.731***	0.450***	-0.029
		(0.256)	(0.286)	(0.175)	(0.734)	(0.226)	(0.302)	(0.163)	(0.199)
	σ_γ	1.947***	0.105	1.642***	1.737***	3.089***	0.736	1.678***	1.735***
		(0.700)	(0.734)	(0.550)	(0.657)	(0.687)	(0.752)	(0.552)	(0.629)
	$\rho_{\alpha,\beta}$	3.136***	2.915***	0.849***	0.410	4.601***	4.204***	2.546***	1.240***
		(0.327)	(0.310)	(0.215)	(1.004)	(0.374)	(0.391)	(0.262)	(0.254)
	$\rho_{\alpha,\delta}$	2.036***	-0.401	2.621***	2.719***	1.228***	-2.148***	0.555**	2.372***
		(0.373)	(0.302)	(0.287)	(0.323)	(0.266)	(0.400)	(0.256)	(0.275)
	$\rho_{\alpha,\gamma}$	2.195***	2.085***	1.249***	1.881***	1.114**	-0.602	1.393***	1.421***
		(0.596)	(0.641)	(0.471)	(0.584)	(0.552)	(0.665)	(0.473)	(0.545)
	$\rho_{\beta,\delta}$	4.188***	3.678***	3.145***	-0.034	2.257***	4.024***	0.199	-1.832***
		(0.422)	(0.319)	(0.431)	(1.491)	(0.259)	(0.410)	(0.294)	(0.388)
	$\rho_{\beta,\gamma}$	-0.846	-1.991**	-0.115	0.770***	2.619***	1.283*	1.748*	1.137***
		(0.523)	(0.861)	(0.214)	(0.271)	(0.392)	(0.702)	(1.012)	(0.247)
	$\rho_{\delta,\gamma}$	1.910***	1.306	0.562	2.187***	-0.655	1.768**	-1.299	-0.381
		(0.461)	(1.289)	(1.474)	(0.408)	(1.083)	(0.875)	(1.375)	(1.898)
Num. obs.		5502	4690	5642	4802	5474	4466	5782	4900
Log Likelihood		-2694.870	-2258.310	-3154.751	-2627.669	-2561.110	-2044.930	-3345.357	-2797.021

Notes: All regressions are random parameters Logit regressions, standard errors in parentheses. "Female" is an indicator of being female. "Age (10y)" is the age of the respondent divided by 10. "Political: Left" is an indicator variable taking value 1 if the respondent indicated to vote on a party on the left side of the political spectrum (Socialist-, Green-, Animal- or Labor party). "Politics: Conservative" is an indicator variable taking value 1 if the respondent indicated to vote on a conservative party (Christian Union, Christian Democratic Union, Calvinist party or Liberal party). "Married" is an indicator variable taking the value one if the respondent is married. "Divorced" is an indicator variable taking the value one if the respondent is divorced. "High education" is an indicator variable taking the value one if the respondents has obtained a college degree or higher. "# children" is the number of children of the respondent. "Home ownership" is an indicator variable taking the value one if the respondent owns a house. "Self-employed" is an indicator variable taking the value one if the respondent is self-employed. */**/** denotes significance at the 10% / 5% / 1% level.

Table E-1

Parameter estimates, random parameter Logit model with ex-post inequality attitude alone.

	<i>HealthGains</i>	<i>HealthLosses</i>	<i>WealthGains</i>	<i>WealthLosses</i>
γ	-2.398*** (0.113)	-2.121*** (0.107)	-2.293*** (0.111)	-1.709*** (0.092)
σ_γ	2.725*** (0.173)	2.349*** (0.161)	2.508*** (0.166)	1.813*** (0.145)
Log Likelihood	-3358.553	-3516.012	-3377.106	-3711.489
Num. obs.	5502	5642	5474	5782

Notes: All regressions are random parameters Logit regressions, standard error in parenthesis. */**/** denotes significance at the 10% / 5% / 1% level.

5.2. Implications for modeling social welfare

Several papers have implicitly modelled inequality aversion as the tradeoff between efficiency and equity by assuming that the social welfare function is additive with convexity to the origin (e.g., Atkinson, 1970; Abasolo and Tsuchiya, 2004, 2013; Dolan and Tsuchiya, 2009, 2011; Robson et al., 2017).⁵ In our framework, a social planner does not face such a tradeoff; a planner trades off different distributions, whilst efficiency stays constant. As a result, identifying the different components of social risk preferences required keeping the expected outcomes of both recipients constant across the lotteries and avoiding mixed lotteries. That is, in the experiment respondents neither faced tradeoffs between gains and losses nor did they face tradeoffs between efficiency and equity to rule out efficiency motives and loss aversion (i.e., overweighting of losses relative to gains; Tversky and Kahneman, 1992). Many social policies, however, involve such tradeoffs, and there is evidence that respondents weight losses in longevity and wealth more heavily than gains (e.g., Tversky and Kahneman, 1992; Attema et al., 2016) and make tradeoffs between efficiency and equity in the health domain (e.g., Johannesson and Gerdtham, 1996; Dolan et al., 2005; McNamara et al., 2020). In addition, the likelihoods of all outcomes in the experiment were exogenously given while the likelihoods of the outcomes of real social policies are typically unknown (e.g., Fleurbaey, 2018). There is evidence that people shy away from such uncertain policies due to ambiguity aversion (e.g., see Trautmann and van de Kuilen, 2015). A promising direction for future work is incorporating behavioral factors beyond ex-post and ex-ante inequality aversion such as aversion toward losses and ambiguity into (measurements of) social welfare functions.

5.3. Implications for social policy

In the domain of losses, respondents are averse to collective risk, ex-ante inequality and ex-post inequality, but our analysis shows that respondents are neutral toward individual risk for health and wealth. Risk aversion for gains and risk seeking for losses is the common finding in individual decision under risk (Tversky and Kahneman, 1992; Wakker, 2010), a sign effect that appears to, at least partly, carry over to the social decision context (Attema et al., 2015). Given that many important social risks (such as the risks of global warming) concern the allocation of burdens rather than benefits, this finding has important implications for social policies. In settings involving reductions in health and income, a social policy based on the assumption of neutrality to individual risk is more aligned with society's preferences, compared to a policy assuming individual risk aversion.

Our findings add to the debate on how to properly manage catastrophic risks (e.g., Keeney, 1980; Fishburn and Sarin, 1991; Fleurbaey, 2018). As an example, consider a (potential) catastrophe that reduces the longevity of the whole population by 50 years with probability 10%, and a social policy designed to prevent the occurrence of the catastrophe at a cost of reducing the life expectancy of half the population by 5 years (and no reduction in life years for the other half). It is well known that in such settings, risk aversion implies a preference for a social policy that concentrates risks (i.e., for avoiding the catastrophe), while inequality aversion implies a preference for spreading the risk over the whole population, i.e., a preference for the catastrophe (e.g., Fleurbaey, 2018). Intuitively, this is because the catastrophe has potential negative consequences for the whole society which is preferred to a social policy that negatively affects half the society if society is sufficiently inequality averse. Using fatalities as outcomes, previous studies have observed a preference to spread the risk among society, i.e., catastrophe acceptance (e.g. Keller and Sarin, 1988; Rheinberger and Treich, 2017). We confirm catastrophe acceptance for equiprobable outcomes in health and wealth: we observe a preference for facing risk rather than inequality in both domains. Moreover, we observe that the preference to spread risk (i.e., to accept a catastrophe) is stronger in the loss domain and stronger for highly educated respondents. As a result, even though respondents are inclined to avoid catastrophes because catastrophes incur collective risk, respondents prefer it over a social policy designed to prevent the occurrence of the catastrophe because it affects everybody in the society equally and thus does not create (ex-post and ex-ante) inequality. Finally, the results of the parametric decomposition suggest that catastrophe acceptance for losses in longevity is mainly due to individual risk neutrality; respondents are not averse to the fact that the catastrophe exposes individual members to risk.

⁵ In such a framework, the degree of convexity typically determines how the social planner trades off equity and efficiency. For instance, if the degree of convexity of the social welfare function is small, social welfare becomes of the inequality-neutral utilitarian-type where the social planner only cares for efficiency and maximizes the sum of individual utilities, irrespective of how these utilities are distributed across society. On the other hand, if the degree of convexity becomes large, social welfare approaches the efficiency-neutral Rawlsian-type social welfare function, where the social planner maximizes the position of the worst-off, irrespective of efficiency concerns.

We are the first to show that policy evaluation should take into account separate attitudes toward social risk, i.e., individual risk, collective risk, ex-post inequality and ex-ante inequality. Moreover, we show that uniformity of attitudes across domains (e.g., gains and losses) and type of outcomes (wealth and health) should not be automatically assumed when designing social policy. As an illustration of the implications of our findings for social policy, let us consider the policies depicted in Table 1. Based on our parameter estimates, a social planner should opt for investing in public health surveillance.⁶ This is mainly because public health surveillance reduces the income risk of workers in both sectors, and our estimates suggest that the social planner is (strongly) averse to individual risk in the gain domain. However, when the same policies would involve monetary losses instead of monetary gains (e.g., reductions in income compared to a reference income), our results suggest that the social planner should opt for the opposite policy of not investing in public health surveillance; in the loss domain the social planner is better able to cope with the income risk of workers as she is neutral toward individual risk. Despite being hypothetical, this example illustrates the implications of erroneously assuming uniformity of social risk attitudes across gains and losses. Overall, our results stress the importance of considering different dimensions of social risk preferences when managing social health and wealth risks, as social risk preference is a multifaceted construct.

6. Conclusion

We report the result of an artefactual field experiment designed to decompose social risk preferences into four different dimensions: viz., an individual risk dimension, a collective risk dimension, an ex-post inequality dimension and an ex-ante inequality dimension. First, aversion to risk and inequality is the mean preference for outcomes in health and wealth in the domain of gains and losses. The decomposition of these attitudes reveals that attitudes toward individual risk are moderated by the domain of the outcomes; respondents are risk neutral for individual members of society in the loss domain for health and wealth. These results highlight the importance of considering different components of social risk preferences when managing social health and wealth risks.

CRedit authorship contribution statement

Arthur E. Attema: Conceptualization, Formal analysis, Methodology, Project administration, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing. **Olivier L’Haridon:** Conceptualization, Data curation, Formal analysis, Funding acquisition, Methodology, Project administration, Validation, Visualization, Writing – original draft, Writing – review & editing. **Gijs van de Kuilen:** Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Validation, Visualization, Writing – original draft, Writing – review & editing.

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Appendix A. Experimental instructions

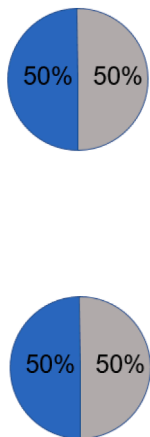
[Instructions of the HealthGains treatment; translated from Dutch. Instructions of the other treatments can be found in the codebook downloadable from the LISS website]

This questionnaire consists of 14 choices between two options. There are no right or wrong choices in this questionnaire. It is only about what you prefer to choose. We ask you to carefully consider which option you prefer when making each choice.

In total, we ask you to choose 14 times between two options: Option 1 and Option 2. Both options yield an increase in the number of years of life for 2 imaginary persons (named person A and person B for convenience) with a certain probability. When making your choice, we ask you to remember that both persons are equal on all elements (gender, age, education, etc.). Since both persons are the same age and do not differ in all other aspects such as health status, both persons have the same life expectancy.

The probability that an option yields a certain outcome is always 50%: a wheel with a blue and a gray half is spinned: the probability of blue (or gray) is therefore 50%. See the example below:

⁶ According to our estimates, the social welfare of not investing is -3.34 and the social welfare of investing is -2.73 ; as the latter is higher than the former, the social planner would prefer investing in public health surveillance.



Option 1	Person A	Person B
Blue (50% chance)	+ 25 years	+ 5 years
Grey (50% chance)	+ 5 years	+ 25 years

Option 2	Person A	Person B
Blue (50% chance)	+ 25 years	+ 25 years
Grey (50% chance)	+ 5 years	+ 5 years

You have to imagine that the outcomes of both options represent the amount of life years that are added to the current life expectancy of the person (which is equal for both persons).

In option 1, person A lives 25 years longer than expected if the outcome of the spin of the wheel is blue (50% probability) and person B lives 5 years longer than expected. If the outcomes of the spin of the wheel is gray (with 50% probability), person A lives 5 years longer than expected while person B lives 25 years longer than expected. In option 2, both person A and person B live 25 years longer than expected if the outcome of the spin of the wheel is blue (50% probability). If the outcome of the spin of the wheel is gray, person A and Person B live 5 years longer than expected.

You are asked to make similar choices between options. The outcomes of the option are different each choice. Please take a close look at both options before making your choice.

Appendix B. Choices in the *HealthLosses*, *WealthGains* and *WealthLosses* treatments

(Table B-1)

Appendix C. Individual characteristics, descriptive statistics and statistical tests on the differences between subsamples

(Table C-1).

Appendix D. Demographic and individual characteristics

For each treatment, *HealthGain*, *HealthLosses*, *WealthGain*, *WealthLosses*, we estimated the random parameter Logit model with two sets of fixed effects. First, we account for demographic characteristics only (gender and age). Then, we added the individual characteristics, namely political orientation, marital status and number of children, income and home ownership, education level and self-employment status. Results are reported in Table D-1: the model with demographic characteristics is denoted (a), the model with the full set of individual characteristics is denoted (b).

Appendix E. Composition effects

(Table E-1).

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