Pure altruism and misjudgement

A bad combination?

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Abstract

Stated preference studies on the value of health risk reductions have found valuations elicited from a private perspective to be both higher and lower compared to valuations elicited from a public perspective. Although relevant, the individual's ability to correctly predict the valuation that other individuals assign to the risk reduction has been insufficiently researched. We aim to verify whether individuals exhibit pure altruistic preferences and if this is the case, whether the presence of pure altruism leads to biased valuation of public risk reductions due to misjudgement about other individuals' preferences. We conduct a large-scale online incentivised experiment as a variant of a public good game in which the individual's final endowment is determined by choices made in the experiment. Results suggest that individuals act as pure altruists and hence try to account for the benefits obtained by others of being insured. The results also suggest that individuals fail to correctly predict other individuals' benefits from the insurance, which leads to non-optimal outcomes and biased valuations.

1. Introduction

It is well-established that individuals are concerned with the well-being of others and that utility functions are interdependent (Arrow, 1974; Bergstrom, 1982). In order to ensure that public sector policies are aligned with citizens' preferences, it is therefore relevant to consider and account for this interdependency. In countries with a public health sector a key objective is to continuously reconfigure the health insurance package to ensure access to vital health care services. This involves ensuring that the financial responsibility is appropriately shared, thereby minimising the financial risk to the individual (future) patient. Stated preference (SP) methods can be applied to estimate the value of access to specific health care services and the associated improvements in health. Such valuations are framed either as choices made in a private insurance setting or a public insurance setting, with the latter encompassing altruistic motives in addition to self-interests. SP studies have found public valuations to be both higher than private valuations (Araña & León, 2002; Gyrd-Hansen, 2015; Pedersen, Gyrd-Hansen, & Kjær, 2011) but, in contrast to expectations, also lower than values elicited in a private insurance setting (Gyrd-Hansen, Kjær, & Nielsen, 2016; Johannesson, Johansson, & O'Conor, 1996). These latter counterintuitive findings are highly prominent in the value of a statistical life literature where a meta-analysis of 74 stated preference studies found the value of a statistical life to be 80% higher when WTP was elicited in the private

perspective compared to a public perspective (de Blaeij, Florax, Rietveld, & Verhoef, 2003). This finding has been backed up by more recent studies (Hultkrantz, Lindberg, & Andersson, 2006; Svensson & Johansson, 2010).

To understand the divergence in estimates across perspectives, attention must be drawn to three key related issues which may play a role. Firstly, a distinction must be made between pure altruistic and paternalistic altruistic preferences. Secondly, reflections are required on the choice of payment vehicle and the implications this has on valuations given these two possible preference sets. Thirdly, to the extent that individuals exhibit pure altruistic preferences, the participant's ability to correctly predict the value that other participants assign to the good in question should be verified.

Jones-Lee (1991, 1992) and Bergstrom (1982) make a distinction between paternalistic altruism and pure altruism. Paternalistic altruism refers to a situation in which an individual cares about a specified dimension of other individuals' welfare. This implies that the individual's utility function contains a single parameters of other individuals' utility function. Paternalistic altruism can for example be health-focused or wealth-focused, depending on which dimension of other people's lives the individual perceives to be paramount. As paternalistic altruism is strictly positive, the inclusion of paternalistic altruism in the valuation of positive increments in health outcomes will all else equal lead to higher valuations than similar health outcomes elicited from a private perspective (e.g. Araña and León (2002)). Pure altruism, on the other hand, refers to situations where the individual is concerned with the overall welfare of others and hence respects other individuals' preferences. In this case another person's utility will enter directly into the individual's utility function.

Whether an individual is a pure altruist or a paternalistic altruist may lead to different reactions to the choice of payment vehicle. When valuations are elicited from a private perspective, out-of-pocket payment or private insurance premium are the relevant payment vehicles. In contrast, if valuations are elicited from a public perspective, the payment vehicle can be either non-coercive donation or, as is more often the case, coercive (uniform) taxation. If the chosen payment vehicle is a uniform[1] coercive tax, the pure altruist will consider the implications an increase in coercive payment has on others' utility as the implications for others is salient (Beeson, Chilton, Jones-Lee, Metcalf, & Nielsen, 2019; Gyrd-Hansen et al., 2016; Johansson, 1994; Jones-Lee, 1991,

[1]The same applies to other distributions of payments such as progressive tax provided that the tax premium to others will not be a function of their WTP

1992;Messer, Poe, & Schulze, 2013). In this case pure altruism can impact positively or negatively on the valuation of public goods. For instance, an individual may be concerned about coercing others into having to pay the same amount for the public initiative as herself, if she believes that other individuals value it less than she does. This may imply that the individual will state a lower willingness to pay (WTP) relative to what she would have paid in a private perspective. Vice versa, the individual may state a higher WTP relative to her private valuation is she believes that other individuals value the good more than she does. In contrast, for the health-focused paternalistic altruist, the choice of payment vehicle has no impact on the social value, as the payment of others is not of interest.

According to Bergstrom (1982) and Jones-Lee (1991, 1992) pure altruism may lead to inflated valuations (also referred to as 'double counting') if the pure altruist only considers the benefits of the public good to others and not the costs. Johansson (1994) demonstrates that unbiased estimates of the value of a risk reduction can be obtained if participants are asked to state their WTP conditional on all other individuals paying an amount that keeps them at their initial level of utility. This condition not only ensures unbiased estimates but entails that any altruistic motivations are annulled and that a pure altruist should state a WTP for the public good equal to her private valuation. Likewise, Beeson et al. (2019) show that unbiased estimate can be obtained from a range of payment vehicles when choices are made under veil of ignorance. Although such payment settings may ensure unbiased WTP estimates, they are not commonly applied. This is most likely because they are less credible and can be criticised for not representing the genuine payment mechanism (coercive tax) used to financing public insurances.

We assert that applying coercive tax can in principle generate unbiased welfare estimates. However, when public goods are funded by coercive (uniform) taxation and individuals hold pure altruistic motivations, it becomes critical that individuals have a good sense of how policy initiatives impact the marginal utility of others. Gyrd-Hansen et al. (2016) found suggestive evidence that the combination of participants being pure altruists and at the same time wrongfully estimating other people's valuations leads to underestimation of the true social value of health risk reductions when payments are coercive.

The aim of this paper is twofold. First, we aim to verify whether individuals encompass pure altruistic motives when evaluating public goods. To do this we elicited preferences for a social insurance with (uniform) coercive payment. Second, we verify if the presence of pure altruism leads

to biased valuation because individuals hold wrong beliefs about the value that the other individuals assign to the public good. We conduct a large-scale online incentivised experiment where participants are given an initial endowment and a risk of losing it. Participants are then given the possibility of buying either a private or a public insurance which will eliminate the risk and subsequently asked how much they will be willing to pay for such an insurance. The study is about preferences for reduced financial risk. Since WTP for public goods is ultimately about ensuring access to all without compromising individual welfare, we argue that these financial risks proxy the possible social welfare implications of increased risk of adverse events, including health incidents.

Our study extends previous literature on public valuations and altruism in multiple ways. First, compared to other studies which have looked at the presence of pure altruism, we operate with a larger representative sample of the general population and we are able to link individual responses with administrative data on e.g. socioeconomic status and health state. Second, our study is unique as it has been designed with the purpose of measuring both participants' beliefs about other individuals' valuation of the good and how they react to corrections in these possibly wrong beliefs. Third, we apply an incentivised public good experiment in which the individual's final endowment is determined by the choices made in the experiment.

2. Conceptual framework

Following the terminology of Jones-Lee (1991) and Gyrd-Hansen et al. (2016) we distinguish between (1) pure selfishness, (2) paternalistic altruism and (3) pure altruism. The paternalistic altruist focuses on one or more single parameters in the other individuals' utility function. For ease of presentation, and in line with our experiment, we refer to the paternalistic altruist as a risk-focused individual. Imagine two individuals i and j each with an initial endowment of 1,000 Danish Kroner (DKK) and a risk of losing the endowment with probability ρ^{i0} There exists an insurance which will reduce the probability to ρ^{i1}. The utility of each individual is given by V^{i0} without insurance and V^{i1} with the insurance. The price of the insurance is denoted c_i if it is a private insurance, and t if it is a public insurance. The public insurance covers all individuals in the society and will be financed through a (uniform) coercive tax. For simplicity, we assume that the utility function only consists of two components: the initial endowment y and the probability ρ of losing

the endowment. Without the insurance, the utility function for individual i conditional on each of the three types of individuals is given by the following three equations.

The selfish individual who is concerned only about own utility:

$$V_{selfish}^{i0} = V^i(\rho^{i0}, y^i) \quad (1)$$

The risk-focused altruist who is concerned about others' risk:

$$V_{risk}^{i0} = V^i(\rho^{i0}, y^i, \rho^{j0}, \dots, \rho^{n0}), \qquad i \neq j \quad (2)$$

The pure altruist who is concerned about others' utility:

$$V_{pure}^{i0} = V^i(\rho^{i0}, y^i, V^{j0}(\rho^{j0}, y^j), \dots, V^{n0}(\rho^{n0}, y^n)), \qquad i \neq j \quad (3)$$

All three types of individuals will be willing to buy the private insurance if their utility with the insurance is higher than their utility without the insurance:

$$V_{selfish\,/\,risk/pure}^{i1_{private}}(\dots) \geq V_{selfish\,/\,risk/pure}^{i0}(\dots) \quad (4)$$

Under a public insurance scheme, it holds that the selfish individual obtains the same level of utility as from the private insurance when $t = c_i$ (assuming no deadweight loss is generated from the public insurance):

$$V_{selfish}^{i1_{public}}(\rho^{i1}, y^i - t) = V_{selfish}^{i1_{private}}(\rho^{i1}, y^i - c_i) \quad (5)$$

For the same expected loss, this implies that the selfish individual i should express the same WTP irrespective of whether the insurance is private or public entailing that $WTP_{selfish}^{public} = WTP_{selfish}^{private}$.

The risk-focused altruistic individual obtains a higher level of utility from the public insurance when $t = c_i$ because it also decreases the risk for individual j from ρ^{j0} to ρ^{j1}:

$$V_{risk}^{i1_{public}}(\rho^{i1}, y^i - t, \rho^{j1}, \dots, \rho^{n1}) > V_{risk}^{i1_{private}}(\rho^{i1}, y^i - c_i, \rho^{j0}, \dots, \rho^{n0}) \quad (6)$$

which entails that the following should be observed $WTP_{risk}^{public} > WTP_{risk}^{private}$.

For the pure altruistic individual, the outcome depends on the level of information individual i possesses about individual j. When information is incomplete, there exist two possible outcomes according to the beliefs that individual i has about j:

$$\frac{\partial \hat{V}^j}{\partial \rho^j}\left(\rho^{j1} - \rho^{j0}\right) - \frac{\partial \hat{V}^j}{\partial y^j} \cdot t_i \begin{cases} < 0, & \rightarrow V_{pure}^{i1_{public}} < V_{pure}^{i1_{private}} \\ > 0, & \rightarrow V_{pure}^{i1_{public}} > V_{pure}^{i1_{private}} \end{cases} \tag{7}$$

where $\hat{V}^j$ is the value function which individual i thinks individual j possesses and again assuming that $t_i = c_i$. The term $\frac{\partial \hat{V}^j}{\partial p^j}\left(\rho^{j1} - \rho^{j0}\right)$ represents the utility which individual i believes individual j gains from being insured (the reduction in risk) and $\frac{\partial \hat{V}^j}{\partial y^j} \cdot t_i$ is the loss in utility individual i believes individual j gets from having to pay t_i for the insurance.

According to Equation (7), if individual i believes that the net-value to individual j for the coercive insurance with premium t is negative, individual i will value the public insurance less than the private *ceteris paribus*. This also implies that the pure altruistic individual i will state a WTP for the public insurance scheme *below* her WTP for the private insurance. In contrast, if individual i believes that the net-value to individual j for the insurance with premium t is positive, a pure altruistic individual i will be willing to pay an excess for the public insurance. Expressing Equation (7) in terms of WTP we get:

$$\frac{\partial \hat{V}^j}{\partial \rho^j}\left(\rho^{j1} - \rho^{j0}\right) - \frac{\partial \hat{V}^j}{\partial y^j} \cdot t_i \begin{cases} < 0, & \rightarrow WTP_{pure}^{public} < WTP_{pure}^{private} \\ > 0, & \rightarrow WTP_{pure}^{public} > WTP_{pure}^{private} \end{cases} \tag{8}$$

Under full information, individual i knows the preferences and the risk of individual j, and thus the exact price of the insurance, which would make j indifferent between being insured and not being insured. If this new information deviates significantly from i's initial beliefs about $\hat{V}^j$ it would entail a change in the stated WTP of i:

$$\hat{V}^j(\dots) \begin{cases} < V^j(\dots), & \rightarrow WTP_{pure}^{public} < WTP_{pure}^{public\ full\ info} \\ > V^j(\dots), & \rightarrow WTP_{pure}^{public} > WTP_{pure}^{public\ full\ info} \end{cases} \tag{9}$$

3. Experimental design

We conducted an online incentivised field experiment during the Fall of 2019. The experiment was carried out during a total period of 4 weeks of which the first week was used to run a pilot of the experiment. A representative sample of 10,500 individuals aged 18-80 was invited through e-Boks[2]. The invitation letter informed the participants that 10% of the participants would have a chance of winning up to 1,000 DKK (approx. 130 EUR).

The participants were told that they were going to play different monetary games[3], each with a possible payoff of up to 1,000 DKK and that it would be decided at the end of the experiment if one of their games was drawn for actual pay-off. After logging on to the experiment, the participant was randomly assigned to either a high or a low risk treatment. If assigned a high (low) risk, the participant would be faced with a series of games wherein she would have a risk of 80% (20%) of losing the initial endowment. In addition, participants were randomly allocated to one of three frames varying the source of the financial risk: 1) an unexpected incident unrelated to health (such as a strike of lightening or bursting waterpipes), 2) an unpreventable unexpected illness, and 3) unexpected illness caused by poor lifestyle. We used these three frames to ascertain generalisability. We found few negligible differences in results across frames, and hence we report only totals[4]. This implies that our results are likely not to be context specific, and true for valuation tasks that offer access to free health care (i.e. full insurance), as well as access to other publicly provided services.

In each game, the individual's risk was illustrated graphically using a pie chart. The participant was then given the opportunity to buy an insurance which would provide full coverage (essentially reducing the risk to 0%) against the monetary loss and asked how much she would be willing to pay for the insurance. For incentive compatibility, we employed the Becker–DeGroot–Marschak (BDM) mechanism (Becker, Degroot, & Marschak, 1964). The mechanism implies that the price of the insurance was decided by drawing a random number within the interval 1:1000. If the WTP provided by the participant was higher or equal to the insurance price, she paid the price and got the insurance. If the WTP was lower than the actual price, she did not get the insurance and would

[2] e-Boks is a secure online mailbox which is linked to an individual's civil registration number and has been mandatory for all Danish citizens since 2014. Exemption can be granted under special circumstances. In the fourth quarter of 2019, 92% of all Danish citizens over the age of 15 had an e-Boks (Digitisation, 2020)

[3] The experiment contained a fourth game on individual risk preferences not relevant to this study and therefore not reported.

[4] Results from the individual frames are reported in the Appendix in Figure A1 and Table A3. Minor difference across frames were only observed for beliefs of low risk WTP.

hence face the risk of losing her initial endowment. The outcomes of the independent games were not revealed to the participant to ensure that behaviour was not driven by accumulated payoff.

To ease the process of understanding the game and the BDM mechanism, we introduced the participants to a test game (non-incentivised) after a set of written instructions were completed. In the test game, the participant was able to state a WTP for the insurance and then get feedback on the insurance price and possible payoff. The feedback included the random price of the insurance and a brief text informing the participant about the outcome of the test game. If her stated WTP was lower than the price of the insurance, the participant was told that she was not able to buy the insurance and hence had a risk of losing all her money. The participant was then asked to push a button to reveal whether she was lucky to avoid the bad outcome or unlucky to lose her endowment. The test game was repeatable, and participants were encouraged to redo the test game again. On average, the participants tried the test game three times.

The first real game, which we will refer to as Game 1 (Private), was a private insurance game, implying that the participants was asked to state a WTP for an insurance solely against a personal loss. Subsequently, the participant was asked to state what she believed other individuals faced with a) the same level of risk, and b) the opposite level of risk would be willing to pay for the insurance. The purpose of these two questions (named Belief 1 and Belief 2) is twofold. First, they enable us to elicit the beliefs which the individual participant has about others' preferences (measured in terms of WTP). Second, they force the participant to think about the benefit of insurance on other individuals and hence the questions also acted as warm-up questions for the second game. In Game 2 (Public - private info), we introduced the participant to a public scenario. Participants were assigned into groups of four individuals, two with high risk and two with low risk, to ensure equipoise. The participants were also told which risk profile they belonged to and shown a graphical illustration of the groups to make sure they understood the relative differences in risk among the participants. In the public scenario, the insurance provided coverage for all the group members and the payment was coercive. This implied that all four participants either paid the same sufficient amount and received full insurance coverage, or no one received the insurance and faced individual risks of losing their endowment. Similar to Game 1, the price of the insurance was decided by the BDM mechanism whereas the group's WTP was chosen by randomly drawing a single individual's WTP. This implied that all group members were equally eligible of deciding the WTP for the insurance of the entire group. The next Game 3 (Public - full info) continued from Game 2 (Public - private info). This time the participant was provided with full information about the other three

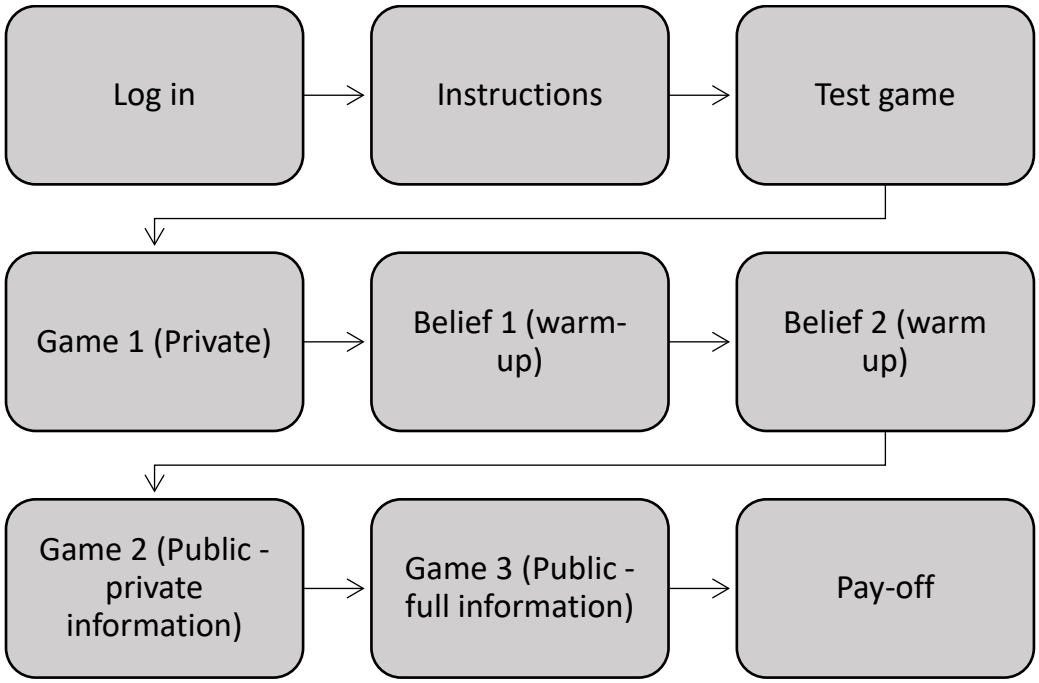
group members' WTP for the insurance (based on answers to Game 1) before asked again to state her (potentially adjusted) WTP for the group insurance. The WTP of the other three group members were sampled from answers collected during the pilot phase of the experiment, and hence Game 3 was not part of the pilot.

Using a random number algorithm, respondents were chosen to receiving actual pay-outs from one of the three games. For the group games (Games 2 and 3) participants were sequentially joined in groups of four and the WTP of the group was always drawn from the first respondent assigned to a group. This ensured an authentic payment mechanism while at the same time allowing respondents to participate successively.

After completing the games, the participants were asked to state their general certainty to their WTP bids on a scale from 1 (very uncertain) to 5 (very certain).

Figure 1 provides a flowchart of the composition of the experiment and the ordering of the different games. The ordering of the games and questions was deliberately chosen to minimise the cognitive burden on the participants starting with the easiest task and building on from there. First, the individual had to think about her own WTP, then the WTP of others with the same degree of risk, followed by others with a different risk, and lastly a combination of all three concerns.

Figure 1: Flowchart of the experiment



A translated version of the experiment can be found in the Online Appendix.

3.1. Analytical strategy

To assess the representativity as well as the distribution of underlying socioeconomic status and health between high- and low-risk individuals, we extract information on participants highest achieved level of education, income, and health state from the administrative data. Since each observation is linked with the social security number of the participant, we can link these with the corresponding individual level data from the administrative sources.

Income is measured as household yearly disposable income corrected for family size and age distribution within the household/family to account for household economics of scale (Hagenaars, De Vos, Asghar Zaidi, & others, 1994). Education is measured as the highest achieved education using the International Standard Classification of Education (ISCED). The participant's health state is measured using the validated Charlson Comorbidity Index (Charlson, Pompei, Ales, & MacKenzie, 1987; Quan et al., 2011). The index is based on the 10th version of the ICD codes (ICD-10) obtained from the Danish National Patient Registry from the previous 5 years.

To test whether participants preferences contain any degree of pure altruism, we test for differences in private WTP of Game 1 (Private) vs. public WTP from Game 2 (Public - private info) for each level of risk using two-sample t-test. On average, we expect that high-risk individuals predict their own net-value of the insurance to be higher than the rest of the group (containing two low-risk individuals and one high-risk individual). Hence, according to Equation (7), if pure altruism is present, high-risk participants will on average state a lower WTP in the public game scenario. Contrary, we expect the exact opposite behaviour for low-risk individuals leading to higher valuation in the public setting. As this difference in WTP is the same as for individuals exhibiting paternalistic altruistic motivation (Equation (6)), only comparison of WTP for high-risk individuals allow us to decipher pure altruism from paternalistic altruism. Consequently, we formulate the following hypotheses allowing us to test if the participants exhibit preferences that match those of a pure altruist.

Hypothesis 1 (H1): *High-risk individuals value the insurance lower when it is public than when it is private:*

$$H1: WTP_{public}^{high} \leq WTP_{private}^{high}$$

Where $WTP_{private}^{high}$ denotes the WTP from the private scenario in Game 1 (Private) and WTP_{public}^{high} denotes the WTP from the public scenario in Game 2 (Public - private information) for a high-risk individual.

If we fail to reject H1 and therefore find support for $WTP_{public}^{high} \leq WTP_{private}^{high}$, we hence confirm the presence of pure altruism. This could lead to biased estimates of the true value of a public good in evaluation studies if the participant has misjudged the WTP of the other participants and hence their derived utility from the insurance/public good.

To test if this is in fact the case, we set up our second hypothesis:

Hypothesis 2 (H2): *Individuals have adequate beliefs regarding other individuals' preferences:*

$$H2: WTP_i^{belief_j} = WTP_{j:\,private}$$

where $WTP_i^{belief_j}$ denotes what participant i believes that participant j is willing to pay for the insurance and is obtained from either Belief 1 or Belief 2 depending on the risk which individual i is subjected to. $WTP_{private}^{j}$ denotes what individual j is willing to pay for the insurance in a private scenario and this value is obtained from Game 1 (private). If we reject H2, it means that individuals are misjudging the true WTP for the other participants. If we find support for H1 and reject H2 we can use Game 3 (Public - full info) to estimate how much the participants adjust their WTP after being informed about the WTP of the other respondents. If an individual is a pure altruist, he should correct her WTP if shown that her initial beliefs about the other participants' WTP are wrong. To test if this is in fact the case, we regress this correction on the degree of misjudgement. If the coefficient on the degree of misjudgement is significantly different from 0 it tells us that there is some weight assigned to the utility of others, which provides further evidence that pure altruism is present.

4. Results

Apart from income, the randomisation of the participants into high- and low-risk appears successful. There are no differences in gender, age, education, and comorbidity across the high-risk group and the low-risk group, however high-risk individuals have a slightly higher income compared to low-risk individuals (see Table 1). We do not find any significant difference in the income between high- and low-risk individuals who dropped out. The difference in income across the samples is therefore likely to be a coincidence and random.

In total, 2,140 of the 10,500 invited individuals completed the online experiment giving a final response rate of 20.4%.

Table 1: Descriptive statistics

	Risk	Mean	SD	P-value[a]
Female	High	0.52	0.50	0.16
	Low	0.51	0.50	
Age	High	48.5	17.12	0.37
	Low	49.16	16.39	
Education				
↪ Low - ISCED 0-2	High	0.18	0.38	
	Low	0.16	0.37	
↪ Medium - ISCED 3	High	0.47	0.50	0.28
	Low	0.45	0.50	
↪ High - ISCED 4-8	High	0.33	0.47	
	Low	0.36	0.48	
Income (000s)	High	291.66[b]	137.28	0.00
	Low	318.48[b]	183.07	
Charlson Index	High	0.24	0.78	0.53
	Low	0.22	0.68	
Practice attempts	High	3.19	5.16	0.03
	Low	2.81	2.59	

Notes: [a] Indicates the p-value for differences between high- and low-risk.
t-test for numeric variables and χ^2 for categorical variables
[b] Measured in DKK. 100 DKK corresponds to 13.5 €

Table 2 summarises the WTP answers for all the included games/scenarios and a bootstrapped 95% confidence interval separated by the assigned risk[5]. To test hypothesis H1 we compare the average WTP for high-risk individuals in the private scenario from Game 1 (Private) with their WTP from the public scenario in Game 2 (Public - private info). As shown in Table 2 participants assigned to the high-risk state a WTP of 445.05 DKK in the private scenario and a lower 392.84 DKK in the

[5] To make sure the results are not affected by the statistically significant difference in income between high and low-risk individuals shown in Table 1 we also control for income when calculating the mean WTP in Table 2. Income is not a significant driver of stated WTP and does not affect our results. Due to the added noise, the confidence intervals widen marginally leading to slightly higher p-values (all differences remain significant at 10% level). The results can be seen in Table A1 in the Appendix.

public scenario. The difference is significant at the 5% level and hence we fail to reject H1 and find support for pure altruism.

To test hypothesis H2 we compare the high-risk participant's perception of a low-risk individual's WTP for insurance to the actual stated WTP values for the two group members exposed to low risk; and vice versa. From Table 2 we can see that high-risk participants on average believe a low-risk individual would be willing to pay 277.71 DKK for the insurance, while low-risk participants on average actually would be willing to pay 318.58 DKK. Contrary, low-risk participants on average believe a high-risk individual would be willing to pay 518.77 DKK for the insurance, while high-risk participants actually would be willing to pay 445.05 DKK on average. We therefore reject H2 and establish that participants misjudge the WTP of the other group members.

Table 2: Mean WTP by game and risk type in DKK

	Risk type	
	High	Low
Game 1: Private	445.05	318.58
	[427.98;461.84]	*[303.50;333.42]*
Game 2: Public (private information)	392.84[a]	357.34[a]
	[377.85;408.12]	*[343.45;371.29]*
Belief 1 & 2		
Low	277.71[b]	334.1
	[262.71;292.04]	*[320.61;346.86]*
High	427.83	518.77[c]
	[412.87;442.72]	*[501.54;535.58]*

Notes: 95% bootstrapped confidence interval using 10,000 iterations in brackets

[a] Indicates public WTP significantly different from the private WTP at the 5% level (p-value: <0.01).

[b] Indicates belief significantly different from the private WTP of a low-risk individual at the 5% level (p-value: <.01).

[c] Indicates belief significantly different from the private WTP of a high-risk individual at the 5% level (p-value: <.01).

To further test the presence of pure altruism, we look at how the participants behaved after they received full information regarding the other participants' WTP in Game 3 (Public - full information). Table 3 reports the model results in which the changes in the participants' WTP (after being revealed the WTP of the other group members) are regressed as a function of how much the individuals actually misjudged the WTP of others. The degree of misjudgement is interacted with

the participant's assigned risk. The variable *misjudge* therefore measures how much the individual's beliefs are incorrect compared to the actual WTPs which are revealed to her[6].

The coefficient on *misjudge* shows that a high-risk participant increases her WTP with 0.31 DKK for each 1 DKK she underestimates the average WTP of the group. Taking the average WTP values from Table 2, a high-risk participant underestimates the average WTP of the group by 18.0 DKK[7] and hence on average increases her WTP with $-18.0 \times -0.314 = 5.65\ DKK$ as a consequence of her degree of misjudgement. The extent to which a pure altruist chooses to correct and thus change her WTP depends on the relative weight which the individual assigns to the utility of the other individuals (Fehr & Schmidt, 2006). These results are in line with the predictions made by the theoretical model in Equation (9).

Table 3: Effect of misjudgement

	Dependent variable:
	Δ WTP when given full information
misjudge	-0.314***
	(0.025)
risk:low	39.049***
	(5.901)
misjudge × *risk:low*	0.077**
	(0.033)
Constant	-33.416***
	(4.226)
Observations	2,140
R^2	0.156
Adjusted R^2	0.154
Residual Std. Error	127.017 (df = 2,136)
F Statistic	131.174*** (df = 3; 2,136)

Notes: *p<0.1, **p<0.05, ***p<0.01.
Bootstrapped standard errors in parentheses (10,000 iterations).

[6] See Equation A1 in the Appendix for detailed specification
[7] $(445.05 + 427.89 + 277.71 + 277.71)/4 - (392.84 \times 2 + 357.34 \times 2)/4$

5. Discussion

Overall, the elicited WTP bids in the present study appears credible. From Table 2 we see that participants exhibited sensitivity to scope when we compare WTP between high and low-risk individuals. We see that individuals assigned a high risk are willing to pay more for the insurance compared to those assigned a low risk. This indicates that participants on average understood the risk they were exposed to and the benefit offered by the insurance.

From Table 2 we see that $WTP_{private}^{high/low} \neq WTP_{public}^{high/low}$. More specifically, we see that high (low) risk individuals lower (raise) their WTP in the public scenario compared to the private scenario. This result means that we fail to reject hypothesis H1 and hence replicate the earlier results found by Messer et al. (2013) and Gyrd-Hansen et al. (2016) showing that individuals facing a risk that is higher than the average individual lower their WTP for the good in a public scenario compared to a private scenario. This result demonstrates that some participants act as pure altruists who predict that the other individuals in the group on average value the insurance differently than themselves according to Equation (6) and Equation (7) respectively. This result is also backed up by the fact that high-risk individuals underestimate the true WTP of low-risk individuals and low-risk individuals overestimate the true WTP of high-risk individuals as seen from the stated beliefs in Belief 1 and Belief 2 from Table 2. Despite this misjudgement we do see that individuals on average are able to correctly predict other individuals' type of risk behaviour.

The results from Table 3 clearly indicate that participants to some extent act as pure altruists. A total of 65% of participants corrected their WTP after being given full information on other participants' WTP. As the games were incentivised (in order to encourage participants to report their true WTP) the correction is not likely to be selfishly motivated, but rather an adjustment of the WTP that is driven by a concern for others. If the individual were solely selfishly motivated or if she were a paternalistic (risk focused) altruist, changes in the utility of others (more specifically an adjustment of the individual's belief about others' levels of utility) would not impact her obtained utility and hence should not lead to changes in her stated WTP.

Our finding that there is a presence of pure altruistic preferences is consistent with the observations made by Gyrd-Hansen et al. (2016) and Messer et al. (2013). Importantly, our study extends this literature in several ways. Besides confirming that individuals exhibit pure altruistic preferences using an incentivised experiment on a large sample of the general public, we are capable of

inferring whether or not participants actually change their valuations if made aware of their wrong beliefs. We thus provide stronger evidence that participants, and thus the general public, have pure altruistic preferences and that they actually misjudge the preferences of other people.

In our experiment we only operate with financial risks. We argue that these financial risks proxy the possible welfare implications of increased risk of adverse events, including health incidents. We find that, irrespective of the source of risk, there is presence of pure altruistic preferences, and misjudgement. However, since our incentivised experimental study elicits the welfare implications of reduced financial effects incurred by for example ill health, and not the welfare implications of ill health per se, future studies should seek to confirm our results. It should however be noted that it would be difficult to make such studies incentivised, which may weaken the quality of the evidence. A recent stated preference study which focused on risk of death also found indications of pure altruism (Gyrd-Hansen et al, 2016).

Social desirability bias has previously been found to affect values in (hypothetical) experiments (Norwood & Lusk, 2011). Although we cannot reject that social desirability might affect the changes in WTP that we observe in Game 3, we do not consider social desirability to be the main driver of our results. We use an incentivised experiment implying that not answering in accordance with own preferences comes at a cost to the individual. Moreover, participants remained anonymous to each other throughout the games (they did not know the identity of the other group members) and we did not provide any feedback to the individual about the other participants adjustments (only information about answers to Game 1 was shared across participants). Both these factors have been identified in the literature to reduce social desirability bias (Colton & Covert, 2007; Mitchell & Jolley, 2012).

It could be argued that participants who are more certain and confident about their WTP for the insurance should adjust less when provided the opportunity, and vice versa for the less certain participants. To test that our results are not driven by this systematic difference in certainty we re-estimated the model from Table 3, controlling for the participants' stated certainty to their WTP (see Table A2 in Appendix). Reassuringly, our results remain robust to this specification suggesting that our findings are not driven by a systematic difference in certainty relating to the WTP bids[8].

[8] We also re-estimated our model controlling for number of test attempts. This does not affect our findings. Results are available from authors upon request.

Based on our results we can conclude that participants exhibit pure altruistic motivation and at the same time to some degree misjudge the benefits to others of being insured. Thus, when analysts apply a public perspective using (uniform) coercive payments (as is most often done and also the most reliable in terms of actual financing) the elicited valuations are likely to be biased. In principle a (uniform) coercive payment should generate unbiased welfare estimates if no misjudgement took place[9]. However, our study shows that there is some degree of misjudgement and that the magnitude and direction of the bias depends on the distribution of the perceived risk/benefit of the individuals from which the valuation is elicited. If individuals with a perceived benefit *above* average are over-represented the elicited value will be negatively biased because they underestimate the benefits that the low-benefiting individuals obtain from the good. Likewise, if individuals with perceived benefits *below* average are over-represented this will result in a positive bias. Our results thus seem to provide an explanation for the contradictory findings observed previously in the literature across public and private valuations. More fundamentally, our findings question the validity of applying a public perspective when eliciting the value of a public good. Pure altruistic preferences constitute a legitimate element of social welfare when individuals face coercive (uniform) payments. Yet our study demonstrates that even when costs are made salient in order to circumvent the problem of exaggerated benefits (Bergstrom (1982) and Jones-Lee (1991, 1992)), valuations remain at risk of being biased due to misjudgement of others' net benefit.

Although the private perspective is the most widely used perspective in stated preference studies, the public perspective is still being applied in some cases. A review of the literature eliciting WTP for a Quality Adjusted Life Year found that two out of 24 studies applied the public perspective (Ryen & Svensson, 2014) whereas another review on the value of mortality risk reductions revealed that 11 out of 35 studies elicited public values (Krupnick, 2007).

Finally, our results also show that when individuals are made aware of their wrong beliefs, they respond to this by changing their stated WTP in accordance with the predictions inferred by the theoretical model.

[9] It should be noted that in the presence of pure altruism elicitation of WTP using a (uniform) coercive payment can only generate a reservation price for a future investment. A precise welfare estimate for a given intervention provided at a given price requires that pure altruists are presented with the actual price that others face, or alternatively that the analyst knows the share of pure altruists, and the weight that they attach to the net benefits of others.

6. Conclusion

This paper adds novel insight on public valuation and altruism. We conducted a large-scale online incentivised experiment on a representative sample of the general public. Using a variant of the public good game we aimed to verify if the combination of pure altruism and participants' inability to judge other individuals' preferences leads to biased valuation of risk reduction in a public insurance setting. We find that participants do in fact act as pure altruists. They are willing to sacrifice own welfare for the welfare of others. Unfortunately, we also show that individuals fail to correctly predict the benefits to others of being insured and hence fail to correctly predict the value to others of a reduced risk of a loss. We provide evidence that the contradictory findings observed previously in the literature between valuation of private and public risk can be explained at least partly by pure altruistic motivation.

Our results have important implications for valuation studies and tax financed public policies. Our findings indicate that the elicitation of preferences for public risk reductions using coercive payments could lead to significant bias and inaccurate policy recommendations. More generally, our results suggest that misjudgement of other individuals' preferences can affect decision making in an unintended way. If this also applies to policy makers, then attempts to embrace public preferences might result in undesirable decisions, and in worst case inefficient allocation of public resources, that do not accord with citizens' preferences.

7. References

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