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Abstract

The value of a Quality-Adjusted Life-Year (QALY) and the Value of a Statistical Injury (VSI) are important measures within health economics and transport economics. Several studies have therefore estimated people's WTP for these estimates, but most results show problems with scale insensitivity. The Chained Approach (CA) is a method developed to reduce this problem. The objective of this study was to estimate the value of a QALY and VSI in the context of non-fatal road traffic accidents using CA. Data was collected from a total of 800 individuals in the Swedish adult general population using two web-based questionnaires. The result showed evidence of scale sensitivity both within and between samples. The value of a QALY based on trimmed individual estimates where close to constant at €300,000 irrespective of the type and size of the QALY gain. The study shows promising results for using the original CA to estimate the value of a QALY and VSI. It also supports the use of a constant value of a QALY, but at a higher level than what is currently applied by HTA's.

Keywords: contingent valuation, chained approach, scale sensitivity, quality-adjusted life-years, willingness-to-pay

JEL codes: D61 D80 I18 J17

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1. INTRODUCTION

In health economics, the typical measure of health benefits is the number of Quality-Adjusted Life-Years (QALYs) gained used for Cost Utility Analysis (CUA) with the aim to estimate the incremental cost per QALY gained. In transport economics, the typical measure of health benefits is the Value of a Statistical Life (VSL), which is derived from the Willingness To Pay (WTP) for a risk reduction and used for Cost Benefit Analysis (CBA) with the aim to estimate the net benefit. When using QALY as the outcome measure, the result does not indicate whether the intervention is worth its cost since the WTP for a QALY is unspecified. When using the VSL as the outcome measure, the question remains on how to value the risk reduction of non-fatal injuries, i.e. the Value of a Statistical Injury (VSI).

One way of deriving the WTP for a QALY and VSI has been to model it from existing VSL (Hirth et al., 2000, Mason et al., 2009, Persson and Hjelmgren, 2003). The value of a QALY can most easily be derived by dividing the VSL with the number of QALYs lost. The VSI can be derived by multiplying the VSL by the relative utility loss of a non-fatal road traffic accident in relation to a fatal road traffic accident. The modelling approach has some limitations since it is restricted to contexts for which there are VSL estimates available (Olofsson et al., 2016a), assumes that the value of a QALY is independent of the type and number of QALYs gained which has been questioned theoretically (Hammitt, 2013), and requires specification of assumptions regarding discounting and the relation between VSL and expected remaining lifetime (Mason et al., 2009).

Another way to estimate the value of a QALY and VSI is to perform a survey of people's WTP for a health gain (Baker et al., 2010, Bobinac et al., 2014, Bobinac et al., 2012, Bobinac et al., 2013, Gyrd-Hansen and Kjaer, 2012, Pennington et al., 2015, Pinto-Prades et al., 2009, Robinson et al., 2013) or WTP for a reduction in the risk of a non-fatal injury (Jones-Lee et al., 1995, Persson et al., 1995). Studies estimating VSI using this approach have however shown that the WTP can be insensitive to the size of the risk reduction, as well as to the severity and duration of an injury. The Standard Gamble (SG) method has been suggested to be a more reliable method for estimating preferences for non-fatal injuries since it encourages respondents to a more careful consideration of the entire prognosis of each health state, creates a situation that respondents might encounter in real life, and do not require respondents to understand small baseline risks and trade off money for small risk reductions (Jones-Lee et al., 1995). However, this method does not deliver a monetary estimate. A combination of Contingent Valuation (CV) and SG was proposed to solve the problem of insensitivity with respect to the size of the risk reduction when estimating the VSL (Beattie et al., 1998, Carthy et al., 1999). This method – called the Chained Approach (CA) - has been shown to be sensitive to scope, easy to understand and internally consistent, but has never been used to estimate VSI.

A modified version of CA has been used to estimate the value of a QALY in order to avoid the need to explain the concept of a QALY for the respondent (Baker et al., 2010, Robinson et al., 2013). The results of these studies, and other CV surveys of WTP for a QALY, are significantly lower compared to estimates modelled from VSL (Ryen and Svensson, 2014). One potential reason for this could be that most studies estimate WTP under certainty (ex post), asking respondents to assume they are in a certain health state. Framing the question this way means that many respondents might hit their budget constraint. It also means that the value of reducing risk per se is not included, adding to the underestimation. There have been attempts to estimate WTP ex ante (Baker et al., 2010, Pinto-Prades et al., 2009, Robinson et al., 2013). Most estimates are however far below those modelled from the VSL, in part because the health gains are still too large for the respondents not to hit their budget constraint. There is one exception, where the health gains presented are much smaller and where the value of a QALY is comparable to that of estimates modelled from the VSL (Bobinac et al., 2014). Since there are both theoretical and empirical support for assuming that the WTP for a QALY is dependent of the size of the QALY gain (Hammitt, 2013) it might be a problem to limit the analysis to small losses.

The objective of this study is to apply the original CA method to derive VSI and the value of a QALY in the context of road traffic accidents. This is to our knowledge the first study using the original CA approach for this purpose. The main advantage with this design is that it allows presenting injuries of different severities while limiting scale insensitivity due to cognitive restraints when faced with small risk reductions, and that it allows presenting varying levels of QALY gains while limiting scale insensitivity due to budget constraints when faced with large QALY gains. The study allows us to test whether the value of a QALY varies depending on the type (fatal and non-fatal) and size of QALY gain. It will also test the performance of the modeling approach for deriving the value of a QALY from VSI and VSL.

The following presentation is organized as follows. Section 2 describes the theoretical framework and the details of the methods used. The result is presented in Section 3 and the article ends with a discussion of the result in Section 4.

2. METHODS

2.1 VSI and VSL

The theoretical model for VSL builds upon the assumption of individuals being expected utility maximizers. The individual faces a situation in which she may die with a certain probability or stay alive. The expected utility (E(U)) in this situation is a function of the probability of death (p) and the utility of wealth when being alive (L(W)) or dead (D(W)) (eq.1) (Jones-Lee, 1974).

$$(Eq.1) \quad E(U) = (1-p)L(W) + (p)D(W)$$

Differentiating the equation while holding expected utility constant gives the marginal rate of substitution (MRS) between wealth and mortality risk reduction, which is equal to the VSL (eq.2).

$$(Eq.2)\ VSL == \frac{L(W) - D(W)}{pD'(W) + (1-p)L'(W)}$$

The theoretical model for VSI is based upon the same reasoning as VSL with the exception of replacing dead with a non-fatal injury and alive with normal health

It is generally assumed that WTP is an increasing, concave function of risk reduction and it is standard to assume that WTP should increase close to proportional in relation to risk reduction (Hammitt and Graham, 1999). Most empirical studies on VSI and VSL fail to show this relationship (de Blaeij et al., 2003, Hultkrantz and Svensson, 2012, Jones-Lee et al., 1995, Lindhjem et al., 2011). The indirect, or chained approach, was developed in response to the failure of the CV method to show scale sensitivity with respect to the size of the risk reduction (Beattie et al., 1998, Carthy et al., 1999). The method is based on two steps, whereof the first involves estimating the MRS of wealth for risk of a non-severe non-fatal injury and the second step involves estimating the relative utility loss for death and the non-severe non-fatal injury.

The VSL or VSI for a more severe injury can be derived by multiplying the relative utility loss by the MRS of wealth for risk of the non-fatal non-serious injury.

The MRS is estimated by specifying the utility function and deriving the WTP and WTA for an injury with certainty (Carthy et al., 1999). We use a different approach where we ask respondents to pay for a complementary insurance that would cover the cost of a treatment that would restore their health within a week if the respondent would suffer a non-severe non-fatal injury. By framing the question this way means that there is no need for specifying in the utility function that the payment is similar to the way healthcare is actually payed for, and that demand side uncertainty are taken into account.

The relative utility loss is estimated by using a modified SG question asking respondents to express the level of ρ when they are indifferent between (1) a treatment that if successful leads to the non-fatal non-serious injury (I), but if unsuccessful lead to death with probability θ, or (2) a treatment that if successful leads to normal health (H) within a few days, but if unsuccessful leads to death with probability ρ ($\rho > \theta$) (Carthy et al., 1999).

2.2 Study design

The study is performed as a web-survey of samples of the Swedish general population identified from internet panels. Two questionnaires were constructed based on the CA method, designed to elicit preferences for three non-fatal injuries and one fatal injury. Injury descriptions were based on the EQ-5D-5L questionnaire (Table 1). Both questionnaires included two WTP scenarios and three SG scenarios (Table 2). The questionnaires differed by the type of injury to avoid in the WTP and SG scenarios. Examples of scenarios are included in Appendix.

<<Table 1>>

<<Table 2>>

2.3 Questionnaire design and scenario presentation

The first part of the questionnaire included questions about the respondent and her transportation habits, experience of accidents, and risk perception. The respondent was then shown the EQ-5D-5L (all dimensions and levels) to make sure that she could place the injury descriptions in relation to full health and her own health. After this, the respondent was presented with the injury descriptions and asked to rate them on a visual analogue scale (VAS) from 0 (worse possible health state) to 100 (best possible health state). Next, the risk was displayed using 1000 blue dots and the respondent was asked to click on one of the dots whereby one of the 1000 dots turned grey to illustrate the concept of risk.

The WTP-part started with an introduction to the WTP concept. The respondents were asked to think about how much they and their household could afford and to answer as if they would have to pay for real. They were also asked to assume that they would not suffer any loss of income if they would become injured and could not work.

After being presented with the WTP scenario, the respondent was shown one amount at a time in numerical order (SEK1, 50, 100, 500, 1,000, 1,500, 2,000, 3,000, 4,000, 5000, 7,000, 9,000 per year) and asked whether she would pay or not pay the amount (Covey et al., 2007, Bateman et al., 2002). Amounts were presented both per month and per year. The range of amounts were set to identify non-payers and to cover what are assumed to be the range of WTP estimates in these kind of studies (Johannesson et al., 1996, Svensson, 2009). Secondly, the respondent was presented with the highest amount she would pay and the lowest amount she would not pay and asked to state her WTP in an open question. Respondents were then asked to rate (on a scale from 0 to 10) how sure she is that she would pay the amount if she were given the opportunity to buy the good for that price. The responses to this question can possibly be used to reduce hypothetical bias, i.e. WTP responses deviating from what the respondent would pay for real (Blumenschein et al., 2001, Loomis, 2014).

The respondents were also asked to state their reasons for paying or not paying using debriefing questions. A follow-up section was included after the WTP scenarios where it was possible for respondents to review and change their WTP. Respondents were also presented with their total WTP for both scenarios and asked if they would be prepared to pay this amount to receive the combined benefit. If the respondent answered no, she was asked to state a new summarized amount.

The SG part started with an introduction to the SG method and an explanation of the purpose of the questions. An interval division approach (EuroVaq Team, 2010) was applied to elicit the point of indifference in the SG questions. The respondents were asked to choose between treatment X (e.g. a slight injury for 6 months and 1 in 1000 risk of a slight injury for rest of life) and treatment Y (e.g. normal health within a week and between 1 and 99 in 1000 risk of a slight injury for rest of life). A maximum of four questions were asked, varying the risk associated with treatment Y depending on the answer of the respondent (Figure 1). If a respondent was not indifferent between treatments at any of the four questions asked, the intermediate risk (between the highest risk rejected and accepted) was assumed to be the point of indifference. Debriefing questions were included to check the reason behind the answers of maximum gamblers, non-gamblers, and indifferent at the first risk presented.

<<Figure 1>>

2.4 Sample

A web-based version of the questionnaire was sent to a randomly stratified sample of individuals from the adult Swedish population drawn from an internet panel. The panel respondents were offered a minor incentive for their participation. Data was collected in January-February 2016. The questionnaire was sent to a total of 2,727 individuals. About half (51%) started to answer the questionnaire and a third (questionnaire slight: 32%; questionnaire moderate: 33%) completed the questionnaire. The majority of the respondents who choose not to complete the questionnaire dropped out in the first WTP scenario. Respondents who completed the questionnaire were older, more educated, and had a higher household income compared to the general population (Table 3).

<<Table 3>>

2.5 Analysis

Protesters, outliers, or irrationals were excluded in the main WTP analysis. Protesters are respondents who do not want to pay because they think the government should pay or respondents who state any WTP because they know they do not have to pay for real (Bateman et al., 2002). Outliers are defined according to the definition of a box plot, i.e. WTP responses that exceed the 75th percentile plus 1.5 times the interquartile range (Lind et al., 2005, Matthews et al., 2016). Irrationals are respondents who state a lower WTP for a higher benefit. Excluding these respondents were considered reasonable in this study since they were reminded of their answer and allowed to change it. A subgroup analysis was also performed where respondents who rated below 7 on the certainty calibration question were excluded. The cutoff at 7 has been supported by previous research (Loomis, 2014), while other studies argues for only treating the respondents rating 10 as certain (Svensson, 2009). If respondents chose to change their WTP after reviewing them in the follow-up section, their final WTP responses were used in the main analysis. The WTP in the main analysis was also adjusted if the respondent were not prepared to pay the summarized amount of both scenarios. The adjustment was made by multiplying the WTP by a factor derived by dividing the new total sum by the old total sum. WTP is reported in SEK (SEK1=€0.10).

The main analysis of the SG responses excluded protesters, irrationals and indifferent at similar risk. Protesters are respondents who provided invalid reasons for taking the highest risk possible or being indifferent at the first risk presented. Irrationals are respondents choosing the treatment with a worse outcome despite it having similar risk as the treatment with a better income.

The VSI and VSL based on the direct method were calculated by dividing the mean WTP for each injury (s) by the pre-defined risk reduction (eq.3).

$$(Eq.3)\ \mathrm{VSL\ orVSI_s} = \frac{\frac{1}{\mathrm{N}}\sum_{\mathrm{i=1}}^{\mathrm{N}} \mathrm{WTP_{s,i}}}{\Delta\ \mathrm{risk}_s}$$

The VSI and VSL, based on the CA method, were calculated by multiplying the relative utility loss derived from the risk-taking in treatment y (p_y) in relation to risk in treatment x (p_x) with the MRS of wealth for risk of the non-fatal injury derived by dividing the mean WTP per year for a cure of a non-fatal non-serious injury (s) by the pre-defined risk of that injury (p_s) (eq.4). The chaining is performed on mean estimates in the main analysis since chaining on individual estimates has been shown to give extreme responses to much impact on the result (Baker et al., 2010, Gyrd-Hansen and Kjaer, 2012).

$$(Eq.4)\ VSL\ orVSI_s = \left(\frac{(1-p_x)}{\left(\frac{1}{\mathrm{N}}\sum_{\mathrm{i=1}}^{\mathrm{N}} p_{y,i} - p_x\right)}\right)\left(\frac{\frac{1}{\mathrm{N}}\sum_{\mathrm{i=1}}^{\mathrm{N}} \mathrm{WTP_{s,i}}}{p_s}\right)$$

The value of a QALY was calculated by dividing the VSI and VSL by the expected QALY loss (Hirth et al., 2000, Mason et al., 2009). The expected remaining life years (y) was based on the sample age distribution and statistics on the expected remaining lifetime for the Swedish population (SCB, 2015). The life-years were not discounted. The reason is that the expected loss of life-years for each individual as presented in the SG scenario was small (max around 4 years). It can be shown that when the loss for each individual is small, the aggregated loss will correspond to the mean undiscounted remaining life expectancy for the individuals in the group (Mason et al., 2009). The quality of life with injury (q_s) was calculated (i) from existing UK population-based value sets for EQ-5D-5L (Devlin et al., 2016) and (ii) ratings on the VAS in the questionnaire. The baseline quality of life (q_b) in the calculation with EQ-5D-5L health states were assumed to correspond to population-based utilities derived with EQ-5D-3L in the Swedish population (Burstrom et al., 2001). The ratings on VAS were adjusted to make death a rate of 0. Respondents rating their own current health worse than death were excluded. The value of a QALY was calculated both based on the ratio of means (eq.5) and based on the means of ratios – using individual chaining and individual QALY gains (eq.6).

$$(Eq.5)\ Value\ of\ a\ QALY_{s,mean} = \frac{\frac{1}{\mathrm{N}}\sum_{\mathrm{i}=1}^{\mathrm{N}} VSI_{s,i}/VSL}{\frac{1}{\mathrm{N}}\sum_{\mathrm{i}=1}^{\mathrm{N}}\left(\left(q_{b,i}-q_{s,i}\right)y_{s,i}\right)}$$

$$(Eq.6)\ Value\ of\ a\ QALY_{s,ind} = \frac{1}{N}\sum_{i=1}^{N}\frac{VSI_{s,i}/VSL_i}{\left(\left(q_{b,i}-q_{s,i}\right)y_{s,i}\right)}$$

A Wilcoxon Signed Ranks Test was used to test for significant differences within groups and a Mann-Whitney U Test was used to test for significant differences between groups.

An OLS regression was performed to validate and explain the result of the logarithm (log) of WTP on age, age squared (defined as (age-mean age)^2), sex, university education, log of income per consumption unit (Statistics Sweden, 2015), response in certainty calibration, transportation habits, injury experience, risk perception, VAS-rating, and risk taking in SG scenarios. The log of WTP and other variables is used to take account of the skewed distribution of WTP and to make the result easy to interpret. Age squared is used to assess if the relationship with WTP takes the form of an inverted U (Shepard and Zeckhauser, 1984). The OLS regression was performed for each scenario separately and for all scenarios pooled.

4. Results

4.1 Utility of health states

The VAS ratings of health states were similar between samples (Figure 2). Respondents' ratings on VAS for own health, slight and moderate injury, respectively, resulted in lower utilities than the corresponding utilities derived based on EQ-5D-5L weights. This is consistent with previous findings. The utility for the severe health state was however worse than death based on EQ-5D-5L weights while it was considered better than death based on VAS.

<<Figure 2>>

4.2 WTP

The WTPs in scenario 1 and 2 were significantly different in both questionnaires, indicating scale sensitivity. Even though risk doubled (from 1 to 2 per 1000) between scenarios in "questionnaire slight" (QS), WTP only increased by 32% in the main analysis. The result in "questionnaire moderate " (QM) suggested an even higher scale sensitivity, since doubling the duration (from 6 to 12 months) leads to an increase in WTP of 51% in the main analysis.

The WTP in scenario 1 was not different across questionnaires among all respondents. The proportion WTP was also similar (Figure 3). There was however a difference (p=0.0106) when protesters and outliers were excluded (Figure 4). The WTP in scenario 2 was different across questionnaire versions among all respondents..

<<Figure 3>>

<<Figure 4>>

<<Table 4>>

4.3 SG

All differences in risk-taking both within and between samples were significant. Respondents were prepared to accept a lower risk probability when there was a worse outcome of the risk (Table 5). Between 23% and 30% who preferred treatment X or were indifferent even though the outcome were preferable in treatment Y were classified as irrationals. The share of this category was lower in QM. The excluded respondents from the SG scenarios were older and less educated.

<<Table 5>>

4.4 VSI, VSL and Value of a QALY

According to expectations, the VSI increased by the severity of the health state (Table 6). The ratios between moderate and slight injury were similar for temporary (1.4) and permanent (1.5) injuries. The corresponding ratios between severe and moderate injury were higher for temporary (3.1) than for permanent (1.1) injuries. One possible explanation for this finding is that there might be diminishing marginal returns with respect to injury severity. Another explanation may be that the temporary version was chained from the slight injury, while the permanent version was chained from the moderate injury. VSL did also vary depending on what health state was used in the chaining, suggesting a failure to show procedural invariance.

The value of a QALY based on utilities derived from the VAS-rating was between SEK 1.6 and 5.7 million. There was a more restricted range in estimates from QM, which could suggest chaining from a more tangible health loss leads to more reliable estimates. The value of a QALY based on utilities derived from weights for the EQ-5D-5L health state varies between SEK 1.3 and SEK 8.6 million. Possible reasons for the larger variation are that the baseline utility is derived from a separate source, and that the relations between injuries do not correspond to the ratings of respondents.

The mean value of a QALY is higher and more inconsistent when using individual chaining (Table 7). This is expected since extreme values are allowed to have more impact on results. The median value of a QALY is however more consistent and the mean value is close to constant across all health states when excluding respondents with a value of a QALY above SEK 10 million (11-44% of respondents).

<<Table 6>>

<<Table 7>>

4.5 Validity

Income was related to WTP in the pooled analysis and QM. The non-significant relation in QS could be a consequence of female respondents having a higher WTP. Age was significantly related to WTP in one scenario and the relationship was consistent with the expected inverted U-shape form. As expected, respondents who were more worried about being involved in a road traffic accident had a higher WTP. Respondents who believed that they could impact risk by own behavior to a large degree did also have a higher WTP. An explanation for this could be that the incentives to pay for a private risk reduction might be higher if experiencing some level of control of the risk. Respondents who believed that they had a higher risk of being involved in a road traffic accident had a lower WTP. A potential reason for this is that having a higher risk in this context could be associated with being less risk averse. As expected, respondents with a higher VAS-rating of their own health had a higher WTP and a higher VAS-rating of the moderate injury was associated with a lower WTP to reduce the same injury. There were only one significant relationship between WTP and risk-taking in the SG scenario, and the relationship was negative which is contrary to what is expected in the chained approach. This is consistent with previous research finding that respondents trading on one scale do not necessarily correspond to the trading on another.

Value of a QALY and VSI estimated with the Chained Approach

<<Table 8>>

5. Discussion

This is to our knowledge the first study deriving a value of a QALY and VSI using the original CA method. The result supports the use of a constant value of a QALY of SEK 3 million irrespective of the size of the QALY loss, as well as the use of the same value of a QALY for fatal and non-fatal outcomes.

A common finding in previous research is that the value of a QALY is higher when the severity is less or when the duration is shorter (Pinto-Prades et al., 2009, Robinson et al., 2013). Insensitivity of WTP has been argued as one explanation for this finding, but it has also been interpreted as a challenge to the assumption of linearity between WTP and QALY. Although this study also showed a less than proportional increase with respect to risk reduction and disease duration in the first part of the chain, there was a limited variation in the value of a QALY.

One reason for the small variation in the value of a QALY found in this study is that several VSI were derived from the same WTP estimate. The variation is therefore primarily a consequence of the SG method, which has been found to be more sensitive to disease duration and disease severity (Jones-Lee et al., 1995). Another reason for the small variation in the value of a QALY is the use of trimming and individual chaining. The result based on individual chaining was found to result in more consistent, and close to constant, values of a QALY. The result of this study shows that chaining on mean estimates may not provide a fair representation since the internal logic at the individual level is lost. The result might be skewed due to the inclusion of respondents with preference on one scale but not on the other, e.g. individuals who state a WTP to avoid the injury but who do not accept any increase in probability of a more severe outcome to avoid the same injury.

The health state used in the first part of the chain did have an impact on the result. VSL based on chaining from the moderate injury was almost 50% higher than VSL based on chaining from the slight injury. This means that the end result is dependent on the choice of health state in the first part of the chain. However, the difference is reduced when using individual chaining. Not taking individual logic and heterogeneity into account is therefore also probably part of the explanation for this inconsistency.

A relatively large share of respondents (23-36%) did not want to take any risk in the SG questions, i.e. they were classified as non-gamblers. This could be a consequence of having to ask respondents to take a risk for a permanent outcome to avoid a temporary outcome. A high share (27%) of non-gamblers has also been reported in a study asking respondents to trade off life-time to avoid a permanent health state (Gyrd-Hansen and Kjaer, 2012), suggesting that the existence of non-gamblers has several explanations.

The design of this study allowed us to identify respondents who behaved irrational, i.e. who still preferred the treatment with a worse outcome or were indifferent between alternatives when the risk was similar in both treatments. It did however made it difficult to know if those who chose the better treatment were taking a risk.

The main analysis of the value of a QALY is based on the rating of quality of life using VAS. This is usually considered a less reliable measurement of health state utilities since it does not require respondents to make a tradeoff. The VAS-rating was however shown to be correlated with WTP, suggesting that it reflected preferences. Ratings on VAS have also been used in other studies of VSI (Jones-Lee et al., 1995) and value of a QALY (Bobinac et al., 2014).

The magnitudes of VSL and VSI in this study are similar to what has been shown in previous studies (Hultkrantz and Svensson, 2012, Lindhjem et al., 2011, Persson et al., 1995). The value of a QALY was estimated to €300,000. A review of studies of the value of a QALY found that the mean estimate based on CV survey responses was €26,189, while the corresponding estimate based on modeling from VSL estimates was €242,371 (Ryen and Svensson, 2014). It was argued in that study that a reason for this difference is that VSL is based on small QALY gains and that the WTP might have been overestimated due to difficulties of comprehending the size of this gain. Our study does however show that the values of a QALY is constant over a wide range of QALY gains, suggesting that this explanation of scale insensitivity with respect to the QALY gain is insufficient. Another possible explanation for the difference between modelled and surveyed value of a QALY is that most CV surveys estimate preferences for health state under certainty. A CV survey estimating preferences for health state under risk (Bobinac et al., 2014) did result in a value of a QALY of €250,500, i.e. similar to what we have found in this study.

The value of a QALY estimated in this study is higher than the current implicit or explicit thresholds used by Health Technology Assessment (HTA) agencies when taking decisions on price or inclusion of the treatment on treatment guidelines. The context in this study is however that of road traffic accidents and it might not be transferable to the healthcare context. The result is however consistent with the value of a QALY in the context of blood-borne diseases (Olofsson et al., 2016c) and cancer (Olofsson et al., 2016b).

This study has shown promising results for using CA to derive VSI and value of a QALY. It has also shown support for a constant value of a QALY that exceeds the current thresholds applied by HTA's.

Tables

Table 1. Questionnaire design

Scenario	Questionnaire "Slight"	Questionnaire "Moderate"
WTP1	Slight injury for 6 months, risk 1 per 1000	Moderate injury for 6 months, risk 1 per 1000
WTP2	Slight injury for 6 months, risk 2 per 1000	Moderate injury for 12 months, risk 1 per 1000
SG1	Slight injury for 6 months vs slight injury for rest of life	Moderate injury for 12 months vs moderate injury for rest of life
SG2	Slight injury for 6 months vs severe injury for 12 months	Moderate injury for 12 months vs severe injury for rest of life
SG3	Slight injury for 6 months vs death	Moderate injury for 12 months vs death

Table 2. Health state descriptions

Health state	**EQ-5D-5L health state**	**Description**
Slight injury ("yellow")	22222	• Slight problems in walking about. • Slight problems washing and dressing yourself • Slight problems doing usual activities • Slight pain and discomfort • Slightly anxious or depressed • Example: concussion, fracture on wrist, whiplash
Moderate injury ("orange")	33333	• Moderate problems in walking about • Moderate problems washing and dressing yourself • Moderate problems doing usual activities • Moderate pain and discomfort • Moderately anxious or depressed • Example: fracture on arm or leg, severe burn injury
Severe injury ("brown")	44444	• Severe problems in walking about • Severe problems washing and dressing yourself • Severe problems doing usual activities • Severe pain and discomfort • Severely anxious or depressed • Example: injury on internal organ, paralysis, brain injury
Fatal injury ("black")	-	• Immediate unconsciousness followed shortly by death.

Table 3. Sample characteristics

	Questionnaire "Slight" (n=419)	Questionnaire "Moderate" (n=461)	p-value
Mean age (Std.Dev.)	53.3 (18.0)	53.6 (17.6)	0.561
Females	48 %	53 %	0.109
One adult in household	29 %	32 %	0.417
Child in household	26 %	23 %	0.233
University education	54 %	54 %	0.910
Employed	48 %	48 %	0.885
Mean household income[a]	43 946	41 516	0.098

[a]Optional question, "Slight" n=370; "Moderate" n=399, transformed from interval using intermediate values.

Table 4. Mean WTP (Std.Dev.), median (SEK per year)

	Questionnaire ”Slight” (n=419)		Questionnaire ”Moderate” (n=461)	
	Slight 6 months, 1 per 1000	**Slight 6 months, 2 per 1000**	**Moderate 6 months, 1 per 1000**	**Moderate 12 months, 1 per 1000**
All	1156 (1952), 500	1234 (1980), 500	1248 (2091), 500	1694 (2443), 800
Excl. protesters[a]	1185 (1972), 500	1264 (1998), 600	1306 (2120), 500	1773 (2478), 1000
Excl. protesters and outliers[b]	616 (637), 475	788 (813), 500	804 (832), 500	1224 (1275), 700
Excl. protester, outliers and irrational[c]	616 (624), 500	812 (817), 500	817 (842), 500	1265 (1283), 800
Excl. protesters, outliers, irrational using final value[d] (main analysis)	**536 (575), 388**	**710 (743), 500**	**738 (800), 500**	**1114 (1164), 600**
Excl. protesters, outliers, irrational, uncertain[d], using final value (main analysis)	588 (592), 485	786 (776), 500	770 (836), 500	1178 (1211), 700
Zero response (n)	7 %	8 %	9 %	8 %
Protesters (n)	3 %	3 %	6 %	5 %
Outliers (n)	12 %	9 %	8 %	7 %
Irrational (n)	6 %	6 %	3 %	3 %
Uncertain (n)	30 %	30 %	35 %	37 %

[a]Non-payers “because government should pay” + Payers stating any amount “because they do not have to pay”.
[b]According to the definition of a boxplot (exceeding Q3 + 1.5 * (Q3-Q1)), WTPslight(1 per 1000)>SEK2820; WTPslight(2 per 1000)>SEK3570; WTPmoderate6>SEK3525; WTPmoderate12>SEK5063
[c]Pay less for more benefit.
[d]Want to adjust their answer in a follow-up question and/or do not want to pay the summarized amount of all scenarios and state a new summarized amount.
[d]Below 7 on a scale from 0 to 10.

Table 5. Mean risk (Std.Dev.), median in treatment Y at indifference between treatment alternatives

	Questionnaire "Slight" (n=419)			**Questionnaire "Moderate" (n=461)**		
	Slight 6m vs slight, permanent	**Slight 6m vs severe 12m**	**Slight 6m vs death**	**Moderate 12m vs moderate, permanent**	**Moderate 12m vs severe, permanent**	**Moderate 12 m vs death**
All	0.018 (0.028), 0.005	0.129 (0.195), 0.03	0.011 (0.021), 0.003	0.027 (0.034), 0.012	0.024 (0.033), 0.006	0.016 (0.027), 0.003
Excl. protesters	0.016 (0.029), 0.003	0.113 (0.188), 0.03	0.009 (0.026), 0.003	0.025 (0.034), 0.006	0.022 (0.033), 0.005	0.015 (0.026), 0.003
Excl. protesters and irrationals	0.022 (0.031), 0.006	0.147 (0.203), 0.05	0.013 (0.023), 0.003	0.033 (0.036), 0.015	0.028 (0.035), 0.006	0.019 (0.029), 0.005
Excl. protesters, irrationals, and indifferent at similar risk (main analysis)	**0.025 (0.032), 0.006**	**0.166 (0.210), 0.075**	**0.015 (0.024), 0.003**	**0.034 (0.036), 0.015**	**0.030 (0.036), 0.012**	**0.021 (0.029), 0.006**
Excl. protesters, irrationals, indifferent or choosing Y at similar risk	0.033 (0.034), 0.015	0.228 (0.228), 0.125	0.029 (0.030), 0.015	0.040 (0.037), 0.022	0.030 (0.036), 0.012	0.033 (0.033), 0.015
Max gamblers (protest[a]) (n)	4 % (0 %)	1 % (0 %)	1 % (0 %)	9 % (1 %)	10 % (1 %)	5 % (1 %)
Indifference at first risk presented (protest[b]) (n)	8 % (6 %)	8 % (6 %)	8 % (7 %)	9 % (8 %)	8 % (6 %)	6 % (4 %)
Choosing X at similar risk =irrational (n)	25 %	22 %	26 %	21 %	20 %	21 %
Indifferent at similar risk (n)	7 %	9 %	10 %	2 %	4 %	7 %
Choosing Y at similar risk (n)	17 %	20 %	30 %	12 %	17 %	27 %

[a]Respondents responding that they choose Y because "I choose anything because the situation is unreal".
[b]Respondents responding that they are indifferent because "It doesn't matter what treatment I get irrespective of the risk in treatment Y", "I don't know, I think it is difficult to compare treatments", or "I choose anything because the situation is unreal".

Table 6. VSI,VSL and value of a QALY based on mean estimates for main sample, in million SEK

Injury	**Estimation of VSI orVSL**[a]	**VSI or VSL**	***QALY 1***[b]	**Value of a QALY 1**	***QALY 2***[c]	**Value of a QALY 2**
Slight 6 months	Direct from WTPS1 and WTPS2	0.4-0.5	*0.094*	3.8-5.7	*0.062*	5.7-8.6
Moderate 6 months	Direct from WTPM1	0.7	*0.188*	3.9	*0.103*	7.2
Moderate 12 months	Direct from WTPM2	1.1	*0.375*	3.0	*0.205*	5.4
Severe 12 months	Chained from WTPS1 and SGS2	3.4	*0.604*	5.6	*0.938*	3.6
Slight permanent	Chained from WTPS1 and SGS1	22.3	*5,88*	3.8	*4.53*	4.9
Moderate permanent	Chained from WTPM2 and SGM1	33.7	*11,83*	2.9	*6.99*	4.8
Severe permanent	Chained from WTPM2 and SGM2	38.4	*18,58*	2.1	*29.82*	1.3
Fatal	Chained from WTPS1 and SGS3	38.4	*24.16*	1.6	*27.60*	1.4
	Chained from WTPM2 and SGM3	55.6	*23.03*	2.3	*26.63*	2.0
Average				**3.5**		**4.5**

[a]WTPS2=WTP questionnaire “Slight”, scenario 2.
[b]Based on utilities calculated from VAS-rating of the respondents.
[c]Based on utilities calculated from EQ-5D-5L weights.

Table 7. Mean value of a QALY (Std.Dev.), median based on individual estimates, in million SEK

Injury	Untrimmed[a]		Trimmed[a]	
	n	Value of a QALY	n	Value of a QALY
Slight 6 months	165	5.3 (9.0), 2.5/ 7.5 (12.3), 3.6	134	2.8 (2.5), 2.1/ 3.3 (2.7), 2.6
Moderate 6 months	201	6.7 (18.0), 2.5	168	2.9 (2.5), 2.1
Moderate 12 months	211	4.1 (5.3), 3.0	188	2.6 (2.4), 1.7
Severe 12 months	147	20.7 (35.1), 2.3	82	3.4 (2.7), 2.9
Slight permanent	117	33.8 (97.2), 6.6	68	3.1 (2.8), 2.6
Moderate permanent	159	24.3 (74.7), 4.1	104	2.9 (2.5), 2.2
Severe permanent	191	15.8 (31.5), 3.9	131	2.8 (2.7), 1.8
Fatal – chained from slight	147	10.7 (40.8), 3.1	114	2.8 (2.7), 1.9
Fatal – chained from moderate	194	20.5 (43.6), 5.2	124	3.0 (2.6), 2.0
Average		**15.0**		**3.0**

[a]Included in main sample, providing answer to both SG and WTP, and rating own health above the health state.
[b]Value of a QALY below 10 million SEK.

Table 8. Regression

VARIABLES	ln(wtp) all scenarios pooled	Questionnaire version 1 ln(wtp) slight 6m, 1 per 1000	ln(wtp) slight 6m, 2 per 1000	Questionnaire version 2 ln(wtp) moderate 6 m, 1 per 1000	ln(wtp) moderate 12 m, 1 per 1000
ln(age)	0.0612	0.147	-0.111	0.284	-0.0294
	(0.154)	(0.386)	(0.383)	(0.271)	(0.263)
ln((age-mean age)^2)	7.91e-05	0.000517	0.000176	9.71e-05	0.000220***
	(6.64e-05)	(0.000460)	(0.000462)	(7.48e-05)	(7.14e-05)
Female=1	0.162	0.400*	0.383*	0.232	0.0599
	(0.108)	(0.227)	(0.225)	(0.193)	(0.183)
University education=1	-0.0602	-0.159	-0.119	-0.271	-0.248
	(0.109)	(0.231)	(0.233)	(0.188)	(0.180)
ln(household income per consumption unit)	0.401***	0.348	0.354	0.436**	0.444**
	(0.124)	(0.233)	(0.232)	(0.186)	(0.177)
Car driver at least once a week=1	0.0340	-0.0311	-0.236	0.262	0.178
	(0.133)	(0.303)	(0.298)	(0.214)	(0.205)
Injured due to road traffic accident=1	-0.133	-0.244	-0.288	0.207	0.150
	(0.107)	(0.214)	(0.215)	(0.190)	(0.182)
Subjective risk above 4 on scale 1-7=1	-0.119	-0.421	-0.227	-0.679**	-0.554*
	(0.213)	(0.412)	(0.416)	(0.318)	(0.305)
Worry above 4 on scale 1-7=1	0.250*	0.626**	0.626**	0.210	0.180
	(0.145)	(0.307)	(0.303)	(0.253)	(0.239)
Control of risk above 4 on scale 1-7=1	0.395***	0.678**	1.070***	0.427*	0.519**
	(0.135)	(0.306)	(0.305)	(0.240)	(0.226)
VAS own health	0.00378	0.0141**	0.0149**	0.00879**	0.00586
	(0.00282)	(0.00591)	(0.00587)	(0.00445)	(0.00431)
VAS slight injury	0.00116	-0.00265	-0.00312		
	(0.00412)	(0.00530)	(0.00529)		
VAS moderate injury	-0.00889**			-0.00937**	-0.0125***
	(0.00420)			(0.00466)	(0.00444)
WTP 2 vs WTP 1	0.267**				
	(0.0345)				
Certainty scale		0.0818	0.111**	-0.0397	0.0294
		(0.0509)	(0.0560)	(0.0394)	(0.0385)
Risk taking SG1		0.143	0.102	0.120	0.0745
		(0.102)	(0.103)	(0.0995)	(0.0956)
Risk taking SG2		-0.0407	-0.0348	0.0574	0.0745
		(0.117)	(0.117)	(0.111)	(0.106)
Risk taking SG3		-0.183*	-0.0811	-0.0448	-0.0153
		(0.101)	(0.102)	(0.0993)	(0.0947)
Constant	1.679	-0.581	0.452	0.889	2.327
	(1.324)	(2.725)	(2.702)	(2.012)	(1.931)
Observations	1,679	221	217	256	258
R-squared	0.058	0.116	0.139	0.125	0.132

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Figures

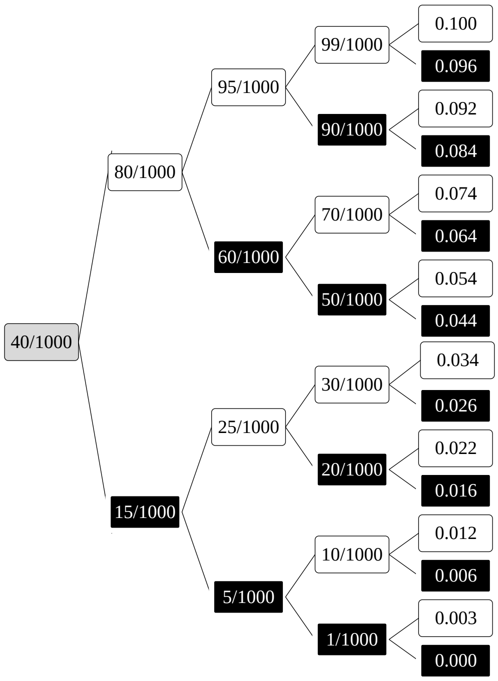

Figure 1. Interval division approach in the SG scenario
Note: Risk of death with treatment Y in the SG question (the same approach was applied for scenario 2 in Questionnaire ”Slight”, divided by 100 instead of 1,000), grey box = starting point, black box = prefer treatment Y, white box = prefer treatment X, end-nodes = interpreted risk of indifference.

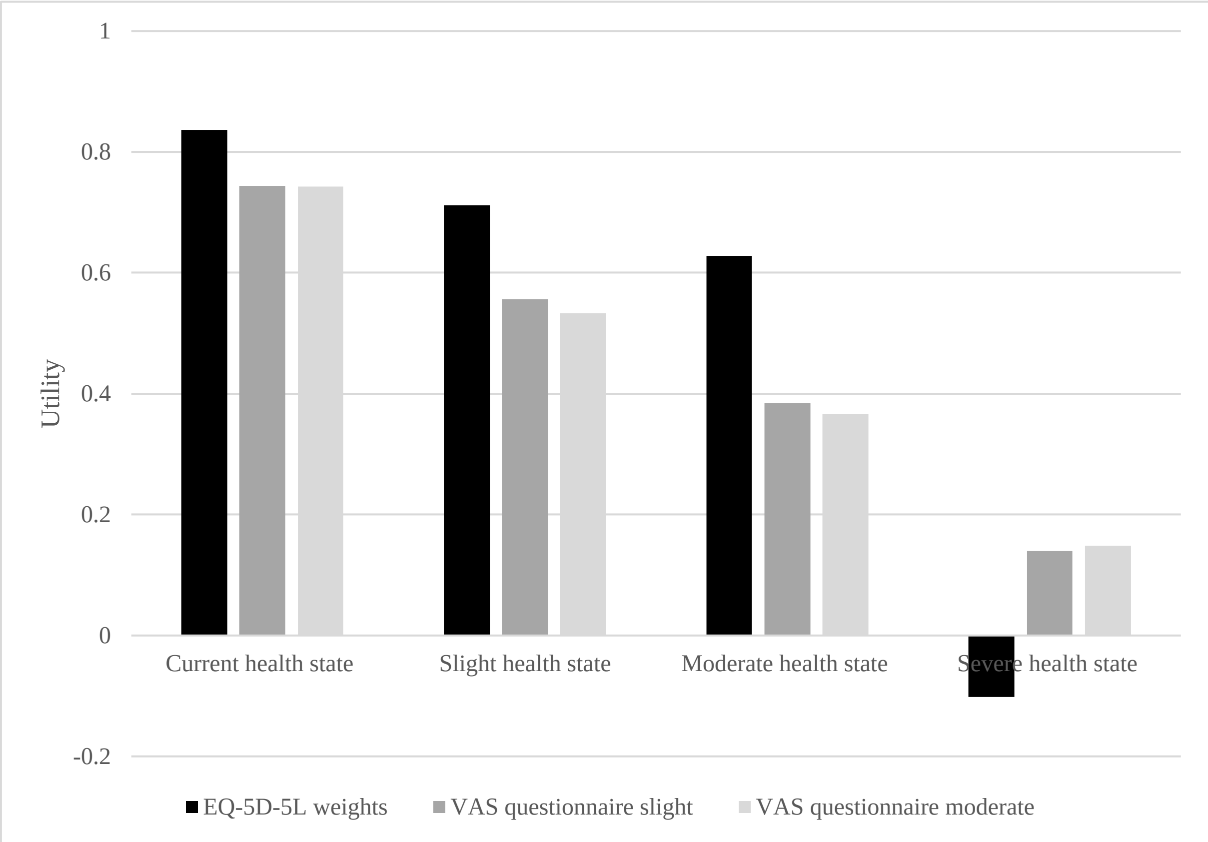

Figure 2. Utility for health states based on EQ-5D-5L weights (current health state: based on a survey of the general population with EQ-5D-3L) and respondents ratings on Visual Analogue Scale (VAS)

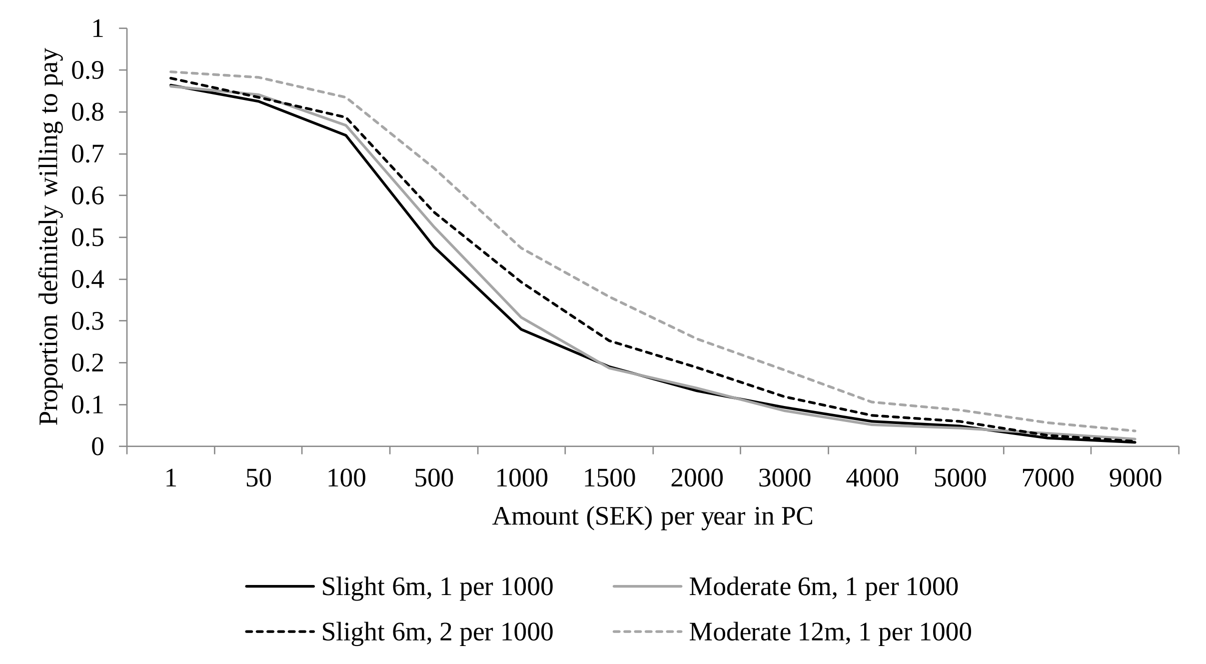

Figure 3. Proportion definitely willing to pay in Payment Card (PC), all respondents

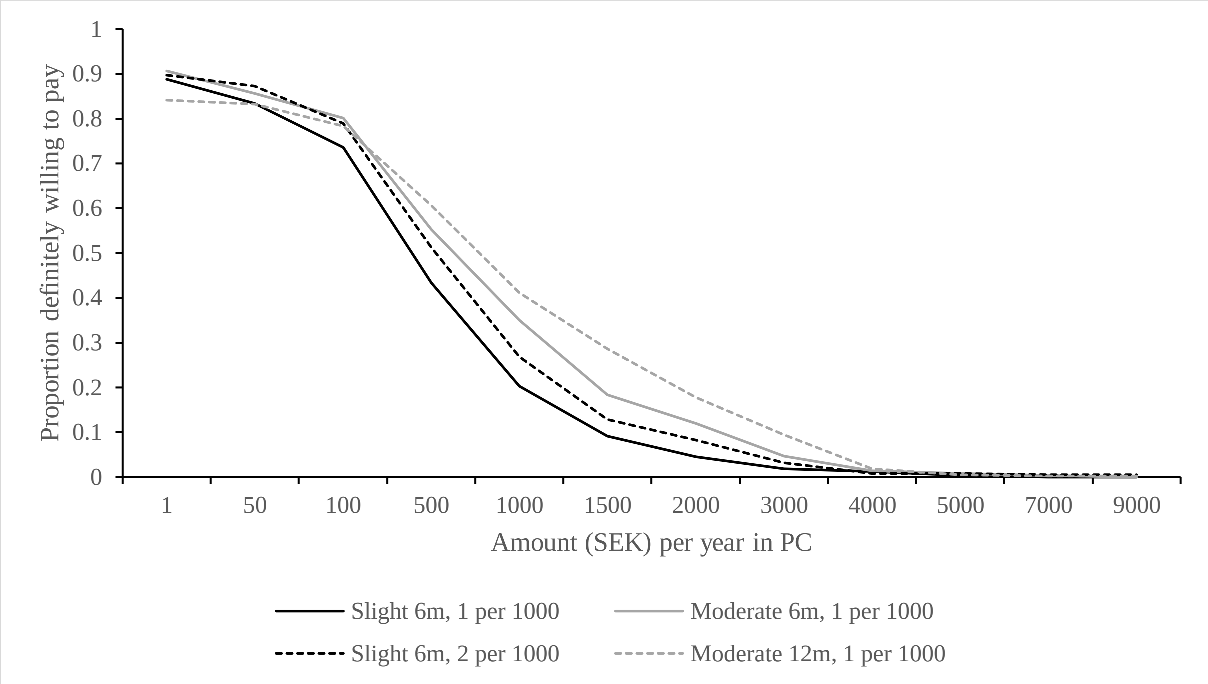

Figure 4. Proportion definitely willing to pay in Payment Card (PC), main analysis

Appendix

Assume that the risk that you will be involved in a less serious road traffic accident that leads to the slight injury in the next 12 months is 2 per 1,000.

[1000 dots whereof 2 were colored yellow]

If you are injured, you will receive a standard treatment, which means that you will live with the following health state for 6 months before you return to your current health:

[A description of the health state and a timeline]

Now imagine that there is an insurance available that would give you access to a treatment that will allow you to return to your current health within a week if you are injured.

What is the highest amount you would be prepared to pay to have access to the insurance for one year?

Figure 2. Example of WTP-scenario

Assume that you have been transported to the hospital after having been involved in a road traffic accident.

Your doctor informs you that there are two different treatments to choose from, which are called treatment X and treatment Y.

You will live with the "slight health state" for the rest of your life if the treatments fail.

[A description of the health state and a timeline]

The chance of success with treatment X is high (999 per 1000) and means that you will live with "the slight health state" for 6 months before you return to your normal health.

[A description of the health state and a timeline]

The chance of success with treatment Y is lower (less than 999 per 1000) but means that you will return to your normal health within a week.

Treatment X. It takes a while to return to your normal health but it is a very safe treatment	**Treatment Y. You can return to your normal health directly but it is a less safe treatment**
• You live with the slight health state for 6 months before you return to your normal health. • The risk of living with the slight health state for the rest of your life is 1 in 1000. [1000 dots whereof 999 colored yellow and 1 colored grey]	• You return to your normal health state within a week. • The risk of living with the slight health state for the rest of your life is X in 1000. [1000 dots whereof X colored grey and 1-X colored blue]

In this situation, would you prefer treatment X, treatment Y or do you consider them equally good?

Figure 3. Example of SG-scenario

References

BAKER, R., BATEMAN, I., DONALDSON, C., JONES-LEE, M., LANCSAR, E., LOOMES, G., MASON, H., ODEJAR, M., PINTO PRADES, J., ROBINSON, A., RYAN, M., SHACKLEY, P., SMITH, R., SUGDEN, R. & WILDMAN, J. 2010. Weighting and valuing quality-adjusted life-years using stated preference methods: preliminary results from the Social Value of a QALY Project *Health Technology Assessment* 14.

BATEMAN, I. J., CARSON, R. T., DAY, B., HANEMANN, M., HANLEY, N., HETT, T., JONES-LEE, M., LOOMES, G., MOURATO, S., ÖZDEMIROGLU, E., PEARCE, D. W., SUGDEN, R. & SWANSON, J. 2002. *Economic Valuation with Stated Preference Techniques - A Manual* Cheltenham, UK Department for Transport, Edward Elgar Publishing

BEATTIE, J., COVEY, J., DOLAN, P., HOPKINS, L., JONES-LEE, M., LOOMES, G., PIDGEON, N., ROBINSON, A. & SPENCER, A. 1998. On the Contingent Valuation of Safety and the Safety of Contingent Valuation: Part 1 - Caveat Investigator *Journal of Risk and Uncertainty,* 17**,** 5-25.

BLUMENSCHEIN, K., JOHANNESSON, M., YOKOYAMA, K. K. & FREEMAN, P. 2001. Hypothetical versus real willingness to pay in the health care sector: results from a field experiment. *Journal of Health Economics* 20**,** 441-457.

BOBINAC, A., VAN EXEL, J., RUTTEN, F. F. & BROUWER, W. B. 2014. The value of a QALY: individual willingness to pay for health gains under risk. *Pharmacoeconomics,* 32**,** 75-86.

BOBINAC, A., VAN EXEL, N. J., RUTTEN, F. F. & BROUWER, W. B. 2012. GET MORE, PAY MORE? An elaborate test of construct validity of willingness to pay per QALY estimates obtained through contingent valuation. *J Health Econ,* 31**,** 158-68.

BOBINAC, A., VAN EXEL, N. J., RUTTEN, F. F. & BROUWER, W. B. 2013. Valuing QALY gains by applying a societal perspective. *Health Econ,* 22**,** 1272-81.

BURSTROM, K., JOHANNESSON, M. & DIDERICHSEN, F. 2001. Swedish population health-related quality of life results using the EQ-5D. *Qual Life Res,* 10**,** 621-35.

CARTHY, T., CHILTON, S., COVEY, J., HOPKINS, L., JONES-LEE, M., LOOMES, G., PIDGEON, N. & SPENCER, A. 1999. On the Contingent Valuation of Safety and the Safety of Contingent Valuation: Part 2 - The CV/SG "Chained" Approach *Journal of Risk and Uncertainty,* 17**,** 187-213.

COVEY, J., LOOMES, G. & BATEMAN, I. 2007. Valuing risk reductions: Testing for range bias in payment card and random card sorting methods *Journal of Environmental Planning and Management* 50**,** 467-482.

DE BLAEIJ, A., FLORAX, R., RIETVALD, P. & VERHOEF, E. 2003. The value of statistical life in road safety: a meta-analysis *Accident Analysis and Prevention* 35 973-986.

DEVLIN, N., SHAH, K., FENG, Y., MULHERN, B. & VAN HOUT, B. 2016. *Valuing Health-Related Quality of Life: An EQ-5D-5L Value Set for England* [Online]. Available: https://www.ohe.org/publications/valuing-health-related-quality-life-eq-5d-5l-value-set-england [Accessed 31 October 2016].

EUROVAQ TEAM. 2010. *European Value of a Quality Adjusted Life Year - Final Publishable Report* [Online]. Available: http://research.ncl.ac.uk/eurovaq/EuroVaQ_Final_Publishable_Report_and_Appendices.pdf [Accessed 7 Sep 2016].

GYRD-HANSEN, D. & KJAER, T. 2012. Disentangling WTP per QALY data: different analytical approaches, different answers. *Health Econ,* 21**,** 222-37.

HAMMITT, J. K. 2013. Admissible utility functions for health, longevity, and wealth: integrating monetary and life-year measures *Journal of Risk and Uncertainty,* 47**,** 311-325.

HAMMITT, J. K. & GRAHAM, J. D. 1999. Willingness to pay for health protection: inadequate sensitivity to probability? . *Journal of Risk and Uncertainty,* 18**,** 33-62.

HIRTH, R. A., CHERNEW, M. E., MILLER, E., FENDRICK, A. M. & WEISSERT, W. G. 2000. Willingness to pay for a quality-adjusted life year: In search of a standard. *Medical Decision Making,* 20**,** 332-342.

HULTKRANTZ, L. & SVENSSON, M. 2012. The value of a statistical life in Sweden: A review of the empirical literature *Health Policy* 108**,** 302-310.

JOHANNESSON, M., JOHANSSON, P. O. & O'CONOR, R. M. 1996. The value of Private Safety Versus the Value of Public Safety. *Journal of Risk and Uncertainty,* 13**,** 263-275.

JONES-LEE, M. 1974. The Value of Changes in the Probability of Death or Injury *Journal of Political Economy,* 82**,** 835-849.

JONES-LEE, M., LOOMES, G. & PHILIPS, P. 1995. Valuing the prevention of non-fatal road injuries: Contingent valuation vs. Standard gambles *Oxford Economic Papers* 47 676-695.

LIND, D., MARCHAL, W. & WATHEN, S. 2005. Statistical Techniques in Business and Economics *McGraw Hill, International Edition, New York, 2005*.

LINDHJEM, H., NAVRUD, S., BRAATHEN, N. & BIAUSQUE, V. 2011. Valuing Mortality Risk Reductions from Environmental, Transport, and Health Policies: A Global Meta-Analysis of Stated Preference Studies *Risk Analysis,* 31**,** 1381-1407.

LOOMIS, J. B. 2014. 2013 WAEA Keynote Address: Strategies for Overcoming Hypothetical Bias in Stated Preference Surveys *Journal of Agricultural and Resource Economics* 39**,** 34-36.

MASON, H., JONES-LEE, M. & DONALDSON, C. 2009. Modelling the monetary value of a QALY: a new approach based on UK data. *Health Econ,* 18**,** 933-50.

MATTHEWS, W., GHEORGHIU, A. & CALLAN, M. 2016. Why do we overestimate others' willingness to pay *Judgment and Decision Making* 11**,** 21-39

OLOFSSON, S., GERDTHAM, U.-G., HULTKRANTZ, L. & PERSSON, U. 2016a. Dread and Risk Elimination Premium for the Value of a Statistical Life *Working Pepers, Department of Economics, Lund University,* 2016:22.

OLOFSSON, S., GERDTHAM, U.-G., HULTKRANTZ, L. & PERSSON, U. 2016b. Measuring the End of Life Premium in Cancer using Individual ex ante Willingness to Pay *Working Pepers, Department of Economics, Lund University,* 2016:23.

OLOFSSON, S., STEEN CARLSSON, K., BERNTORP, E., PERSSON, E., LUND AXELSEN, F. & PERSSON, U. 2016c. Willingness to pay for eliminating the risk of being infected by blood-borne diseases in regular replacement treatment for patients with haemophilia *Nordic Journal of Health Economics* 4**,** 24-43.

PENNINGTON, M., BAKER, R., BROUWER, W., MASON, H., HANSEN, D. G., ROBINSON, A., DONALDSON, C. & EUROVA, Q. T. 2015. Comparing WTP values of different types of QALY gain elicited from the general public. *Health Econ,* 24**,** 280-93.

PERSSON, U. & HJELMGREN, J. 2003. Hälso-och sjukvården behöver kunskap om hur befolkningen värderar hälsan *Läkartidningen* 100**,** 3436-3437.

PERSSON, U., LUGNÉR NORINDER, A. & SVENSSON, M. 1995. Valuing the benefits of reducing the risk of non-fatal road injuries: the Swedish experience *In:* SCHWAB CHRISTE, N. & SOUGEL, N. (eds.) *Contingent Valuation, Transport Safety and the Value of Life* Netherlands: Kluwer Academic Publishers

PINTO-PRADES, J. L., LOOMES, G. & BREY, R. 2009. Trying to estimate a monetary value for the QALY. *J Health Econ,* 28**,** 553-62.

ROBINSON, A., GYRD-HANSEN, D., BACON, P., BAKER, R., PENNINGTON, M., DONALDSON, C. & EUROVA, Q. T. 2013. Estimating a WTP-based value of a QALY: the 'chained' approach. *Soc Sci Med,* 92**,** 92-104.

RYEN, L. & SVENSSON, M. 2014. The Willingness to Pay for a Quality Adjusted Life Year: A Review of the Empirical Literature. *Health economics*.

SCB. 2015. *Livslängdstabell för 2014, uppdelat på män och kvinnor* [Online]. Available: www.scb.se/Statistik/BE/BE0101/2014A01G/Be0101Livslangdstabeller-14.xlsx [Accessed 31 October 2016].

SHEPARD, D. S. & ZECKHAUSER, R. J. 1984. Survival versus consumption. *Manage,* 30**,** 423-439.

STATISTICS SWEDEN. 2015. *Disponibel inkomst per konsumtionsenhet för hushåll 20-64 år efter hushållstyp 2014* [Online]. Available: http://www.scb.se/sv_/Hitta-statistik/Temaomraden/Jamstalldhet/Indikatorer/Ekonomisk-jamstalldhet/Inkomster-och-loner/Disponibel-inkomst-per-konsumtionsenhet-for-hushall-2064-ar-efter-hushallstyp-2014/ [Accessed 7 Sep 2016].

SVENSSON, M. 2009. The value of a statistical life in Sweden: Estimates from two studies using the "Certainty Approach" calibration *Accident Analysis and Prevention,* 41**,** 430-437.