Do individuals have different preferences as consumer and citizen? the trade-off between travel time and safety

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Abstract
Transport policy decisions often involve a trade-off between travel time and safety. Transport economists generally evaluate the societal value of transport policy options involving travel time versus safety trade-offs in a Cost-Benefit Analysis (CBA) through multiplying the expected change in traffic casualties with the value of a statistical life (VOSL) and multiplying the changes in travel time with the (marginal) value of time (VOT). The dominant empirical approach to infer the VOSL and the VOT is based on stated preference experiments in which respondents are asked to make choices between (hypothetical) routes which differ in terms of various characteristics (e.g. travel time and number of fatal accidents per year). This approach towards inferring the VOT and the VOSL has been criticized by scholars who argue that individuals' preferences as consumer of mobility inferred through (hypothetical) route choices may be a poor proxy for how the same individuals in their role of citizen believe that government should trade-off safety and travel time. This study tests whether individuals indeed do have different preferences as consumer and citizen when trading off travel time and safety, by conducting a Stated Choice experiment in which respondents are asked to choose between hypothetical routes as consumer and hypothetical routes/policy options as citizen. We find that individuals in this case indeed have different preferences as consumer than as citizen. As citizen people assign relatively more value to safety compared to travel time than in their role of consumer. Our results question the current CBA practice as addressed above. The most important policy implication of a shift from evaluating transport projects using consumer preferences to evaluating projects using citizen preferences would be that projects which improve safety are likely to be relatively more attractive from a societal point of view when compared to projects generating travel time savings.

1. Introduction

Transport policy decisions often involve a trade-off between travel time and safety. For instance, the principal benefit of replacing "stop" signs by "yield" signs is that it saves motorists time; the main draw-back is that it degrades safety (Hauer, 1994). Transport economists evaluate the societal value of transport policy options involving travel time versus safety trade-offs in a Cost-Benefit Analysis (CBA) through multiplying the expected change in traffic casualties with the amount of money that individuals are willing to pay for reducing the risk of their premature death (the so-called value of a statistical life, VOSL) and multiplying the changes in travel time with the amount of money individuals are willing to pay for travel time savings (the so-called value of time, VOT). In case a transport policy solely results in travel time savings and an increase in the number of fatal accidents per year, transport economists postulate that the policy enhances societal welfare when the aggregated monetary travel time benefits accruing from the policy (i.e. the travel time savings multiplied by the VOT) are larger than the policy's aggregated monetary safety losses (i.e. the additional fatal accidents multiplied by the VOSL).

Inferring the VOT and the VOSL from the amount of money individuals are willing to pay from their after tax income – and establishing the societal welfare effect of policy options through aggregating changes in travel time and safety with these money metrics – has been heavily criticized by numerous economic-philosophers (e.g. Ackerman and Heinzerling, 2002, Hauer, 1994; Kelman, 1981). They argue that respondents participating in experiments for inferring the VOT and the VOSL are asked to trade-off after tax income, travel time and safety in their role as *consumer of mobility*, whilst preferences of individuals in their role as *consumers* may be a poor proxy for how the same individuals in their role as *citizens* believe that Government should trade-off tax money, safety and travel time. For instance, Ackerman and Heinzerling (2002) contest the decision of the US Government against banning cellphone use in the car based on calculations that people who are talking while driving are willing to pay a lot to talk on the phone more than many people who face deadly risks are willing to pay to avoid the risk of being killed. In their view, the consumer values for talking while driving cannot legitimize that some US citizens will end up in the morgue because they are hit by other US citizens distracted by their cellphone while driving a car: "using private market behavior as a standard for public policy overlooks the possibility that people will have different preferences when they take on different roles" (Ackerman and Heinzerling, 2002, page 191).

There are indications in the literature that individuals evaluate mortality risk in a different way in their roles as consumer versus citizen. Cropper et al. (1994) and Johannesson and Johansson (1997) concluded that individuals in their role as citizen attach less importance to government projects saving older citizens than to saving younger citizens. Cropper et al. (1994) found that for the median respondent in their study, saving one 20-year-old is equivalent to saving seven 60-year-olds. Johannesson and Johansson (1997) concluded that Swedish citizens judge saving five 50-year-old citizens equivalent to saving one 30-year-old citizen and saving 34 70-year-old citizens. Interestingly, in both studies it turns out that the age of the respondent has no effect on the observed choices. Both young and old individuals give priority to saving the lives of the younger individuals. Do older consumers also have a lower willingness to pay for risk reductions? Various studies conclude that there is weak support for the notion that the amount of money consumers are willing to pay for reducing the risk of their premature death declines with age (e.g. Alberini et al., 2004; Krupnick, 2007). Krupnick (2007) found in his meta-analysis fourteen studies that did, and twelve that dit not report evidence of a so-called senior discount effect. In conclusion, the literature indicates that the consumer value of reducing mortality risk does not differ between young and old people, whereas the citizen value of reducing mortality risk for younger people is substantially higher than the citizen value for reducing mortality risk for older people. Moreover, Mouter and Chorus (2016) concluded that individuals value travel time savings higher in their role as citizen than in their role as consumer. More specifically, they inferred that individuals' willingness to pay from previously collected tax money for travel time gains created by a government policy, is significantly higher than their willingness to pay, from their after tax income, for time gains obtained by choosing a different route. This difference did not stem from a stronger willingness to spend previously collected tax money compared to spending one's own income, but from a difference in the value attached to travel gains.

Despite the indications in the literature that people evaluate travel time savings and reductions in mortality risk differently as consumer and citizen, to the best of the authors' knowledge, no research has been conducted that empirically tests the claim of the economic-philosophers that individuals have different preferences as consumer and citizen when *trading off* travel time and safety. The key aim of our study is to ameliorate this gap in the scientific literature. Therefore, our research question is: *do individuals have different preferences when trading off travel time and safety as consumer and citizen?* We answer the research question by designing a stated choice (SC) experiment with two experiments in which respondents are asked to choose between two hypothetical routes in their role as consumer of mobility and two experiments in which respondents are asked to recommend a route/road project to the government in their role as citizen. A comparison of the results of the four experiments allows us to answer the research question.

The remainder of this paper is organized as follows: section 2 provides a brief discussion of the literature regarding valuation methods used to transfer travel time savings and improved traffic safety into monetary terms. Section 3 discusses our methodology and section 4 the data collection. Subsequently, we present the results in section 5. In section 6, we draw conclusions and discuss the results.

2. Methods for valuing travel time and traffic safety

Several methodologies are applied to infer the VOSL and the VOT. Early research aspiring to establish these money metrics focused on the direct and indirect economic costs of travel time savings and casualties in traffic (Hensher et al. 2009; Abrantes and Wardman, 2011). In the 1980s this so-called human-capital approach was heavily criticized, since intangible losses such as pain, sorrow and the loss of quality of life were not considered (Bahamonde-Birke et al., 2015). An important conceptual advance in the state of practice of valuation was achieved by valuing according to subjective preferences (e.g. Jones-Lee and Loomes, 2003). In contingent valuation experiments (CVM) individuals are asked directly which amount of money from their after tax income they are willing to pay for reducing travel time or the risk of their premature death, while making a route choice (Hensher et al. 2009). Hence, when deriving the VOSL, respondents are not asked to value specific human lives, but instead are asked to value an undefined statistical life threatened by an eventual risk. However, several scholars (e.g. Rizzi and Ortúzar, 2006) argued that early CVMs did not bear upon actual choices of route selection where individuals have to consider a bundle of attributes describing each alternative (i.e., travel time, toll, and safety associated with each route alternative). Ortúzar and Rizzi (2001) and Rizzi and Ortúzar (2003) were the first proponents of a different approach based on the stated choice (SC) technique. This technique considers the modelling of a hypothetical market, which includes security levels and travel as integral attributes (Bahamonde-Birke et al., 2015). Respondents are asked to make several choices between (hypothetical) routes which differ in terms of various characteristics examples such as cost, travel time and number of fatal accidents per year.[1] The main difference between this approach and CVM lies in the indirect nature of the estimation process of the willingness to pay for nonmarket goods, as it is based on the discrete choice modelling methodology (e.g. Ortúzar & Willumsen, 2001). Experts believe that SC is an appropriate elicitation method for the valuation of intangibles (Bahamonde-Birke et al., 2015; Louviere et al., 2000). Currently, SC is the dominant empirical approach to infer the VOSL and the VOT (e.g. Börjesson and Eliasson, 2014; Hensher et al., 2009; Ojeda-Cabral et al., 2016).

In the SC literature, a distinction can be made between 'consumer experiments' and 'citizen experiments'. Mouter and Chorus (2016) establish that in 'citizen experiments' respondents' after tax income is not affected. Respondents are asked to choose between policy options of the government which deviate from each other in terms of the relevant attributes. From 'citizen experiments', it can be derived to which extent citizens support the allocation of previously collected taxes to a government project from which the effects accrue that are object of the analysis (in this study: travel time and safety). A key characteristic of 'consumer experiments' is that respondents make choices as private individuals and their budget – in terms of after tax income and/or time – is directly affected through their choices (e.g. Fuguitt and Wilcox, 1999; Mouter and Chorus, 2016). For instance, respondents are asked to choose as a car driver (consumer of mobility) between routes which differ in travel time, safety and in impact on their after tax income (e.g. toll costs). Note that our conceptualization of 'citizen preferences': "individuals' preferences over the allocation of taxes" slightly differs from Nyborg's (2000) conceptualization: "the ethical observer judging matters from society's point of view". We illustrate our conceptualization in Figure 1.

	Homo economicus (pursues personal interests)	**Homo politicus** (judges matters from society's point of view)
Consumer: preferences people reveal with their after-tax income	**Self-interested consumer:** An individual thinks that suit X is the most beautiful suit he has ever seen. The individual buys suit X, because this enhances his well-being. The individual is aware of the fact that children in Bangladesh produced suit X in horrible circumstances, but does not internalize this in his purchasing decision.	**Ethical consumer:** An individual thinks that suit X is the most beautiful suit he has ever seen. However, he buys the less beautiful fair trade suit Y, because this coincides better with his views on a good society.
Citizen: Preferences people reveal towards the allocation of tax by the Government.	**Self-interested citizen:** An individual protests against new plans for a collective heating system near his house, even though he is aware of the fact that society at large would reap substantial benefits from the project (Not in My Backyard).	**Ethical citizen:** An individual thinks that the government should invest in a collective heating system in another part of his village, since this fosters sustainability, even though this individual is bothered by the construction of the system when he commutes and he does not reap any personal benefits from the collective heating system.

Figure 1: 'consumer' versus 'citizen' and 'homo economicus' versus 'homo politicus'

Applying the distinction between consumer and citizen experiments discussed above to the VOSL and VOT literature, the studies of Cropper et al. (1994) and Johannesson and Johansson (1997) can be labelled as 'citizen experiments', since respondents are asked to choose between policy options of the government and the after tax income of individuals is not affected. On the other hand, the studies of Bosworth et al. (2010) and Svensson and

[1] Deriving the VOT and the VOSL through route choices is the dominant approach in the literature. However, there are also examples of studies which derive these metrics through other choices, an example being mode choices (Leon and Miguel, 2013).

Johansson (2010) are consumer experiments, since respondents in these experiments are asked how much they are willing to pay from their after tax income for public investments improving safety. Hence, these experiments are no 'citizen experiments', but 'consumer experiments' in which individuals are asked to elicit their willingness to pay for public goods.

3. Methodology

Since the SC data collection paradigm is the dominant approach for eliciting how consumers trade-off travel time and safety, we adopt this approach in our study. For distinguishing 'consumer experiments' from 'citizen experiments' we adopt the definition of Mouter and Chorus (2016). That is, in the consumer experiments, we asked respondents to make route choices and in the citizen experiments, we asked respondents to choose which route or policy option they would recommend to the government.[2] A characteristic of the Mouter and Chorus (2016) study is that respondents participating in the citizen experiments are asked to choose between policy options which differ in allocation of collected taxes which implies that more money is available for other publicly funded projects when the respondent selects the least expensive option. A methodological distinction between Mouter and Chorus (2016) and our study is that the choice options presented to the respondents participating in the citizen experiments in our study do not differ in terms of costs. We decided to present 'cost neutral' options to respondents, since we believe that it is difficult for respondents to make an assumption regarding what will happen with residual tax money if they choose for the least expensive option.

To identify candidate attributes for the choice experiments and to test how respondents assessed the experiments' realism and intelligibility we carried out two pilot surveys. Based on the comments of the participants in the pilot surveys we decided to: 1) Specify the road's number of lanes and the number of trips made on the road on an average day. Respondents argued that this information assisted them in making a choice between the choice options, since this information helped them to assess the risk of the options; 2) Use '5 deaths per year' as the maximum attribute level in the choice options presented to the respondents. Respondents negatively assessed the realism of riskier choice options. Various respondents thought that a road with 10 traffic deaths per year was unrealistically dangerous. Note that 224 car drivers died in the year 2015 in traffic in the Netherlands with only 79 deaths on Dutch motorways (SWOV, 2016).

Based on the pilot surveys we designed four experiments (two consumer experiments and two citizen experiments). Furthermore, we kept the choice tasks in the experiments (in terms of changes in travel time and safety) identical across all experiments, to allow for maximum consistency in our empirical comparisons. This allows us to infer the extent to which individuals have different preferences as consumer and citizen when trading off travel time and safety. Below, we present the four experiments in detail.

<u>Experiment 1: classical consumer route choice</u>

Experiment 1 (see Figure 2) resembles the design used in the previous Dutch VOSL study (de Blaeij, 2003; Rouwendal et al. 2010), in that respondents are asked to choose between two hypothetical routes which differ in terms of travel time, number of fatalities on the road per year and toll costs.

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[2] Because the car is the dominant mode in transport and the VOT and VOSL are generally derived from route choices, we focus in this study predominantly on route choices of car drivers.

Assume the following:

- You drive your car somewhere in the Netherlands and you have to make a choice between two routes
- There are no other persons in the car
- Both routes are tolled. You have to pay the toll yourself
- Both routes are 2x2-lane motorways
- Both routes carry 80,000 trips per day, which means around 29 million trips per year
- 80,000 trips per day corresponds with an average 2x2-lane motorway in the Netherlands
- The routes only differ in terms of travel times, costs and number of fatalities on the road per year
- The routes do not differ in environmental effects and non-fatal accidents, amongst other things

If you have to choose between Route A and B, which route would you choose?

	Route A	Route B
Travel time	40 minutes	30 minutes
Number of traffic deaths on the road	1 per year	5 per year
Toll	4.50 euro	5.50 euro

FIGURE 2 Design of experiment 1.

Experiment 2: consumer route choice (no costs)

For deriving the monetary values of a statistical life and travel time savings it is necessary to include 'costs' as an attribute in the SC experiments. Since, it is only necessary for our research aim to elicit how individuals trade-off travel time and safety as *consumers of mobility* we asked respondents participating in experiment 2 to trade-off two routes which differ in terms of travel time and safety assuming that the routes do not differ in terms of travel costs (see Figure 3).

Assume the following:

- You drive your car somewhere in the Netherlands and you have to make a choice between two routes
- There are no other persons in the car
- Both routes are 2x2-lane motorways
- Both routes carry 80,000 trips per day, which means around 29 million trips per year
- 80,000 trips per day corresponds with an average 2x2-lane motorway in the Netherlands
- The routes only differ in terms of travel times and number of fatalities on the road per year
- The routes do not differ in costs, environmental effects and non-fatal accidents, amongst other things

If you have to choose between Route A and B, which route would you choose?

	Route A	Route B
Travel time	40 minutes	30 minutes
Number of traffic deaths on the road	1 per year	5 per year

FIGURE 3 Design of experiment 2.

Experiment 3: citizen route choice

In the pilot studies we tested different alternatives of experiments in which participants were asked to trade-off safety and travel time in their role as citizen. In the pilot studies, we particularly evaluated the extent to which respondents perceived the citizen experiments to be consequential, in the sense that the respondent answering the questions perceives that his/her answers are potentially influencing the government's actions (Carson and Groves, 2007). Based on the results of the pilot surveys, we decided to emphasize in the experiment that the government aspires to use the results of the experiments in their future decisions.

The experiment which closely resembles the consumer experiment excluding costs (experiment 2) received the most positive evaluations. In this experiment participants are asked to choose between two routes which differ in terms of travel time and safety (see Figure 4). The only deviation from experiment 2 is that participants are asked to recommend one of the two routes to the government instead of choosing one of the two routes as a consumer of mobility.

The government decided to build a new road.
The government still needs to decide about the route of the new road.
The government asks you whether you would recommend Route A or Route B for the new road that the government will build. Below you will find the characteristics of both routes.

Assume the following:

- Both routes are 2x2-lane motorways
- Both routes will carry 80,000 trips per day, which means around 29 million trips per year
- 80,000 trips per day corresponds with an average 2x2-lane motorway in the Netherlands
- The routes only differ in terms of travel times and number of fatalities on the road per year
- The routes do not differ in costs, environmental effects and non-fatal accidents, amongst other things
- The government is interested in general preferences of Dutch citizens. Hence, it is not made clear whether or not you would experience any effects (positive and negative) from either of the two routes

Please select the Route which you would recommend to the government.

	Route A	Route B
Travel time	40 minutes	30 minutes
Number of traffic deaths on the road	1 per year	5 per year

FIGURE 4 Design of experiment 3.

Experiment 4: citizen policy options

In the second citizen experiment which was evaluated in a positive way in the pilot study respondents are asked to choose between two policy options which differ in terms of minutes of travel time saved for 80,000 travelers and reduction of fatal accidents per year (see Figure 5).

The government needs to make choices regarding investments in the road network. There is not enough money to fund all potential road projects.
The government wants to know which type of road projects you prefer.
Hence, the government will present you with two Road Projects and asks you whether you would recommend Road Project 1 or Road Project 2. Below you will find the characteristics of the Road Projects.

You can assume the following:

- Both road projects are investments in 2x2-lane motorways
- Both road projects will affect 80,000 trips per day, which means around 29 million trips per year
- 80,000 trips per day corresponds with an average 2x2-lane motorway in the Netherlands
- The Road Projects only differ in terms of travel times saved and number of fatalities reduced
- The Road Projects do not differ in costs, environmental effects and non-fatal accidents, amongst other things
- The government is interested in general preferences of Dutch citizens. Hence, it is not made clear whether or not you would experience any effects (positive or negative) from the Road Projects

Please select the Road Project which you would recommend to the government.

	Road Project 1	Road Project 2
Reduction travel time for travelers	8 minutes per trip	6 minutes per trip
Reduction in traffic deaths per year on the road	1 per year	5 per year

FIGURE 5 Design of experiment 4.

The attribute levels were selected based on the VOSL and VOT derived from the most recent Dutch Value of Statistical Life study (de Blaeij, 2003) and Dutch Value of Time study (Kouwenhoven et al., 2014), the model results of the pilot surveys and the feedback received from the participants in the pilot surveys (see section 3). We choose the following six time gain levels for experiments 1-3 (30, 32, 34, 36, 38, 40 minutes) and for experiment 4 (2, 4, 6, 8, 10, 12 minutes of travel time savings), the following four traffic safety levels (0, 1, 3, 5 deaths on the road per year), and the following four cost levels for experiment 1 (3.50, 4.50, 5.50, 6.50 euro per trip). In the experiments we did not specify the purpose of the trip to the respondents, since we are interested in the general trade-offs individuals make as consumer and citizen. For constructing the experimental design underlying the SC experiment we used an efficient design (Bliemer and Rose, 2006).

The questionnaire consisted out of four major sections. Firstly, respondents were asked whether they use a car two or more times per week. Respondents who gave a negative answer to this question were excluded from the remainder of experiments 1 and 2. Secondly, after reading through an introductory text, respondents were asked to complete twelve choice situations. The choice situations were presented in random order across respondents, to prevent ordering effects. Since the text preceding the choice tasks is of key importance for our study, we choose to repeat it for every single choice task, for in case respondents wanted to re-read it. Thirdly, respondents were asked to provide some additional information concerning their usual commute. Fourthly, they were asked to evaluate the perceived ease and realism of the choice experiment.

4. Data collection

A survey company (TNS NIPO) was asked to draw four random samples from the population of Dutch citizens of 18 years and older. The survey company was not necessarily asked to draw representative samples, but it was important that all segments in terms of income, age, education and gender were represented and that the samples for the four experiments did not differ substantially on these socio-demographic characteristics. The survey company recruited 532 respondents, each of which was assigned to one of the four frames in such a way that differences in socio-demographic characteristics between different frames were minimized. The survey company provided us with additional information about the socio-demographic characteristics of each respondent (e.g. income, age, education, gender). Tables 1 and 2 show that both the socio-demographic characteristics as well as the answers given by the respondents in the fourth part of the questionnaire did not differ substantially between the four experiments, and as such do not play a role in explaining found differences in trade-offs between safety and travel time between experiments.

TABLE 1 Socio-demographics

Variable	Experiment 1	Experiment 2	Experiment 3	Experiment 4
Gender				
Female	73	59	65	68
Male	58	45	78	82
Age				
18 to 29 yr.	7	7	10	8
30 to 39 yr.	16	12	22	16
40 to 49 yr.	24	17	28	29
50 to 59 yr.	40	35	38	39
60 to 69 yr.	28	20	24	25
70+ yr.	16	13	21	33
Average	**53**	**53**	**52**	**55**
Completed education				
Elementary school	2	4	13	8
Lower education	33	16	28	34
Higher education	58	55	55	66
University education	38	29	47	42
Household income				
$I < 12\,900$	2	2	10	7
$12\,900 \leq I < 27\,000$	15	24	29	26
$27\,000 \leq I < 40\,000$	24	15	27	31
$40\,000 \leq I < 67\,000$	40	39	38	45
$67\,000 \leq I < 79\,900$	20	5	14	15
$I \geq 79\,900$	29	19	25	26
Living in Urban or Rural area				
Less than 500 citizens per km^2	25	23	31	36
500 - 1 000 citizens per km^2	31	24	26	39
1 000 - 1 500 citizens per km^2	31	29	39	30
1 500 - 2 500 citizens per km^2	28	13	33	32
More than 2 500 citizens per km^2	16	15	14	13

An interesting side-observation is that respondents rate the citizen-experiments (experiments 3 and 4) equivalently or better than the consumer experiments (experiments 1 and 2) in terms of the criteria evaluated in the fourth part of the questionnaire (see Table 2).

TABLE 2 Average scores criteria rated in the fourth part of questionnaire

Experiment	**1**	**2**	**3**	**4**
I was convinced of my choices (1 = strongly disagree, 5 = strongly agree)	4.2	4.3	4.5	4.3
I found it easy to trade-off ‘travel time’ and ‘number of deaths on the road’ (1 = strongly disagree, 5 = strongly agree disagree)	3.9	4.1	4.3	4.2
I thought that the questionnaire was realistic (1 = strongly disagree, 5 = strongly agree)	3.5	3.5	3.5	3.6
This experiment provides the government with relevant information for making choices between road projects (1 = strongly disagree, 5 = strongly agree)	3.3	3.4	3.6	3.7

5. Results and models

In section 5.1, we analyze whether respondents participating in the consumer experiments (experiments 1 and 2) make a different trade-off between travel time and safety when compared to respondents participating in the citizen experiments (experiments 3 and 4). In this analysis, we excluded respondents participating in experiments 3 and 4 who filled out in the first part of the questionnaire that they did not drive a car more than two times a week (shortly: ‘non-car drivers’), because only people who drive a car at least two times a week were able to participate in experiments 1 and 2. Hence, excluding 'non-car drivers' who participated in experiments 3 and 4 (citizen experiments) allows us to make a fair comparison between the way consumers and citizens trade-off travel time and safety.

In section 5.2, we analyze whether a specific group of respondents participating in the consumer experiments and the citizen experiments make a different trade-off between travel time and safety this being the respondents who chose at least one time for the safest option and for the fastest option (shortly: traders).

In section 5.3, we analyze how the whole sample of respondents participating in experiments 3 and 4 (citizen experiments) trades-off travel time and safety.

5.1. Trade-offs between travel time and safety of car drivers

5.1.1 Descriptive results

Figure 6 presents for experiments 2-4 the share of respondents who choose for the safest route for offers differing in implied 'minutes per death' embedded in particular choice tasks.[3] For this purpose, choice tasks were ordered in decreasing (embedded) 'minutes per death'. To illustrate, the first choice task represents a trade-off between 10 minutes of travel time and 1 death on the road per year (Route A: 30 minutes travel time, 1 traffic casualty on the road per year; Route B: 40 minutes travel time, 0 traffic casualties on the road per year). In experiment 2 (consumer route choice no costs) 28% of the respondents choose for Route B (the safest route), in experiment 3 (citizen route choice) 66% choose for Route B and in experiment 4 (citizen policy options) 59% choose for Route B. It is easily observed that the share of individuals choosing for the safest route increases when the implied 'minutes per death on the road' decreases. Moreover, we find that the share of respondents choosing for the safest route is considerably higher in the citizen experiments than in the consumer experiment.

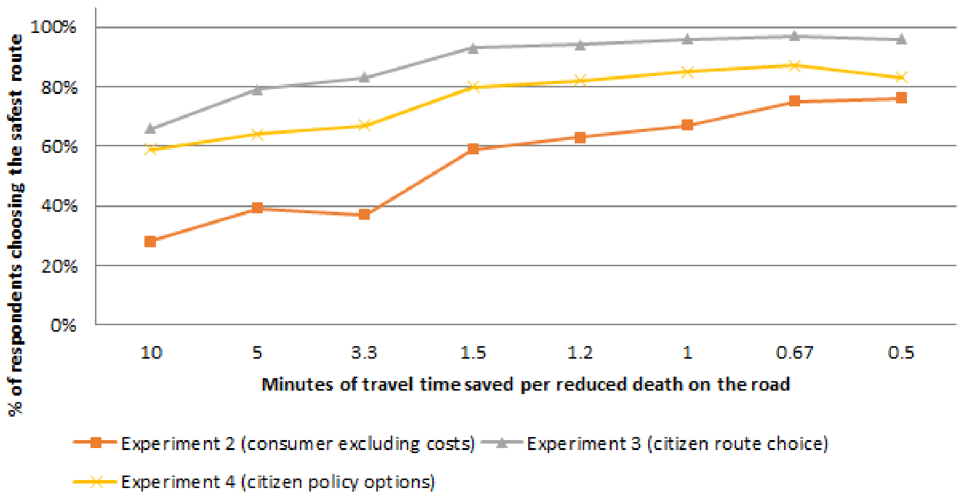

FIGURE 6 Percentage of car drivers choosing for the safest route in experiments 2, 3 and 4.

An interesting difference between the consumer experiments and citizen experiments is the distribution of the non-traders. Non-traders are the respondents who always chose for the safest option, the fastest option or the cheapest option. Hess et al. (2010) distinguish three explanations for non-trading. First, non-trading may reflect the presence of extreme preference whereby non-trading individuals are assumed to be responding as utility

[3] Results of experiment 1 are not displayed, since in this experiment respondents were asked to make a trade-off between three attributes.

maximizing agents but to possess very strong preferences for a particular alternative. Second, non-trading reflects a form of heuristic (i.e., non-utility maximizing) decision making by the respondent, arising from misunderstanding, boredom or fatigue during the SC exercise. For instance, individuals may filter some of the attributes or alternatives presented to simplify the decision making task. Thirdly, non-trading behavior may reflect a form of political or strategic behavior (policy response bias). For instance, respondents believe that through expressing their preferences in this way they can influence policy decisions. Table 3 reveals that in the citizen experiments substantially more respondents always chose for the safest option when compared to the consumer experiments.

TABLE 3 Analysis of non-traders in the four experiments

	Experiment 1 (consumer)	Experiment 2 (consumer)	Experiment 3 (citizen)	Experiment 4 (citizen)
Always chose the safest route	7%	22%	58%	49%
Always chose the fastest route	1%	18%	1%	2%
Always chose the cheapest route	35%	-	-	-

5.1.2 Results Multinomial Logit Model

Next, we analyze our data using discrete choice models. Specifically, we estimate linear-additive Multinomial Logit (MNL) models, as these models allow for straightforward interpretation of the results in terms of marginal rate of substitution (Train, 2009). Table 4 presents the estimation results. In addition, based on the estimates we derived marginal rates of substitution between travel time and safety.[4]

TABLE 4: Estimation results MNL experiments 1-4 Only Car Users

Context	Experiment 1 Classical Consumer route choice			Experiment 2 Consumer route choice (no costs)			Experiment 3 Citizen route choice			Experiment 4 Citizen policy options		
# Observations	1559			1247			1343			1427		
Null LL :	-1080.6			-864.4			-930.9			-989.1		
Final LL:	-701.3			-780.1			-426.3			-735.6		
ρ^2 :	0.35			0.10			0.54			0.26		
Estimates	Est	SE	T	Est	SE	T	Est	SE	T	Est	SE	T
B_Death	-0.342	0.024	-14.30	-0.334	0.027	-12.39	-0.832	0.049	-19.25	0.484	0.029	16.29
B_TravelTime	-0.126	0.011	-11.26	-0.132	0.013	-9.81	-0.051	0.015	-3.72	0.045	0.012	3.69
B_TravelCosts	-1.020	0.048	-21.38									
Marginal rate of substitution												
B_Death/B_Travel Time	**2.71**	0.231	11.73	**2.53**	0.170	15.10	**16.31**	4.350	3.75	**10.73**	2.490	4.30
B_TravelTime/B_Costs	**0.12**	0.009	13.90									
B_Death/B_Costs	**0.34**	0.017	20.20									

B_Death = marginal utility of one additional traffic casualty on a road
B_Travteltime = marginal utility of one additional minute travel time
B_Travelcosts = marginal utility of one additional euro toll costs

A number of inferences can be made based on Table 4. Firstly, looking at the parameter estimates we see that signs are in the a priori expected directions. Secondly, the estimates are all highly significantly different from zero. This implies that all attributes were considered relevant when making trade-offs. Thirdly, and most importantly, our results

[4] Standard errors are computed using the Delta method.

indicate that when individuals are put in a consumer role their marginal rate of substitution is around 2.6 minutes travel time savings per a reduction of 1 traffic casualty on the road per year. However, when individuals are put in a citizen role their marginal rate of substitution increases considerably. The marginal rate of substitution of individuals in a citizen role is found to be respectively 16.3 and 10.7 minutes of travel time savings for 80,000 trips per day per a reduction of 1 traffic casualty on the road per year in experiment 3 and 4. A two-sample t-test shows that the marginal rates of substitution of consumers and citizens are highly significantly different from one another (p = 0.000). To illustrate the interpretation of the results presented in Table 4, consider a government which needs to decide between two route options being Route A: 30 minutes and 2 traffic casualties per year and Route B: 34 minutes and 1 traffic casualty per year. All else being equal, the 'aggregate consumer utility' of Route A exceeds the 'aggregate consumer utility' of Route B, since car drivers derive more utility from 4 minutes of travel time savings than a reduction of the numbers of traffic deaths on the road with one per year. However, all else being equal, the 'aggregate citizen utility' of Route B exceeds the 'aggregate citizen utility' of Route A, since citizens derive more utility from a reduction of 1 traffic casualty on the road per year than 4 minutes of travel time savings for 80,000 trips per day.

Finally, based on the results of experiment 1 the marginal rate of substitution between travel time and travel cost (i.e. the VoT) can be derived. We find a VoT of €7.41 euro per hour. This value is somewhat lower than the current official VoT for car commuters in the Netherlands of €9.00 euro per hour (Kouwenhoven et al., 2014). Furthermore, from experiment 1 we can derive a Value of Statistical Life of €9.7 million. This value is substantially higher than the official Value of Statistical Life of 2.6 million euro per statistical life currently used in the Dutch practice (SWOV, 2012). One possible reason for this deviation is that the data on which the Dutch VOSL is based (de Blaeij, 2003) were gathered 17 years ago (in 1999) and that preferences of Dutch individuals may have changed within this considerable period of time. Note that, the VOSL derived from our study is also higher than the VOSL of €5 million which was established in the de Blaeij (2003) study in which respondents were asked to choose between three different variants of a car that only differed in price and safety (see also Wijnen et al. 2009).

5.2. Trade-offs between travel time and safety of car drivers who make a trade-off

Our data contains a substantial proportion of non-traders (see Table 3). These non-traders are known to cause biased parameters when trying to estimate random parameter distributions in Mixed Logit models as this means that parts of the tails of the distributions are not observed (Hess, 2010). Besides this theoretical problem, a congruent practical problem is that non-traders may also cause identification issues. In this context, we decided to estimate more sophisticated Mixed Logit models based on traders only. Section 5.2.1 first presents the descriptive analyses for the traders-only data. Next, section 5.1.2 discusses the Multinomial Logit and Mixed Logit results.

5.2.1 Descriptive results

Figure 7 presents for experiments 2-4 the share of traders who choose for the safest route for offers differing in implied 'minutes per death' embedded in particular choice tasks. Figure 6 reveals that the share of traders choosing for the safest route is considerably higher in the citizen experiments than in the consumer experiment which echoes the results presented in section 5.1.

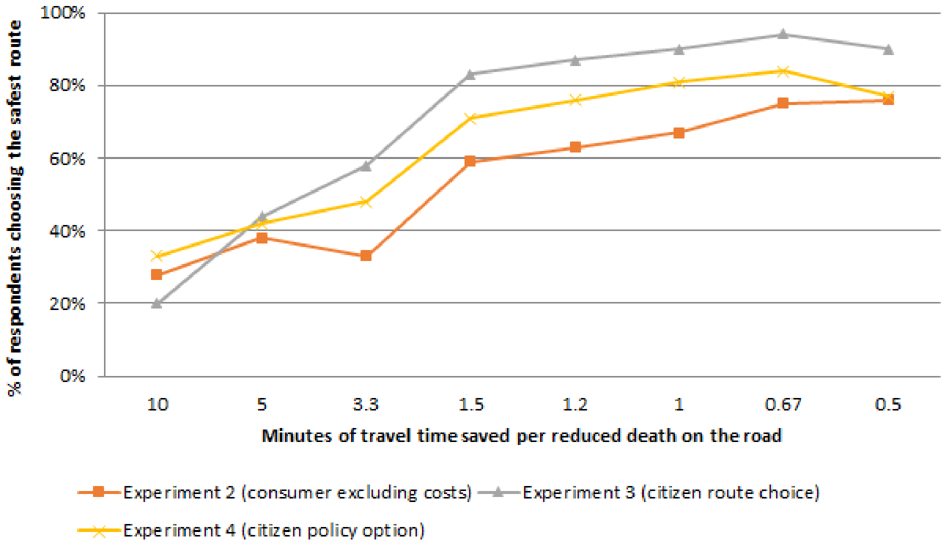

FIGURE 7 Percentage of traders choosing for the safest route in experiments 2, 3 and 4.

5.2.2 Results Multinomial Logit and Panel Mixed Logit

Next, we analyze the traders-only data using discrete choice models. Table 5 presents the estimation results of linear-additive Multinomial Logit (MNL) models. In addition, based on the estimates we derived marginal rates of substitution between travel time and safety.

TABLE 5: Estimation results MNL experiments 1-4 Trading Car Users only

Context	Experiment 1 Classical Consumer route choice			Experiment 2 Consumer route choice (no costs)			Experiment 3 Citizen route choice			Experiment 4 Citizen policy options		
# Observations	899			756			552			792		
Null LL :	-623.1			-524			-382.6			-548.9		
Final LL:	-401.9			-385.5			-230.5			-446.9		
ρ^2 :	0.35			0.26			0.4			0.19		
Estimates	Est	SE	T	Est	SE	T	Est	SE	T	Est	SE	T
B_Death	-0.436	0.034	-12.80	-0.590	0.041	-14.56	-0.806	0.061	-13.50	0.473	0.037	12.78
B_TravelTime	-0.157	0.015	-10.72	-0.252	0.021	-12.25	-0.204	0.023	-9.07	0.130	0.016	7.96
B_TravelCosts	-1.030	0.065	-15.82									
Marginal rate of substitution												
B_Death/B_TravelTime	**2.78**	0.301	9.23	**2.34**	0.212	11.06	**3.95**	0.420	9.41	**3.64**	0.418	8.71
B_TravelTime/B_Costs	**0.15**	0.011	13.65									
B_Death/B_Costs	**0.42**	0.022	19.54									

The marginal rates of substitution for trading car drivers participating in the consumer experiments presented in Table 5 (around 2.5 minutes travel time savings per a reduction of 1 traffic casualty on the road per year) corroborate the results for trading and non-trading car drivers presented in Table 4. The marginal rates of substitution of trading car drivers participating in the citizen experiments (around 3.8 minutes of travel time savings for 80,000 trips per day per a reduction of 1 traffic casualty on the road per year) are substantially lower than the results for trading and non-trading car drivers presented in Table 4. This is caused by the fact that in the citizen experiments substantially more respondents always choose for the safest option when compared to the consumer experiments. A two-sample t-test shows that the marginal rates of substitution of ‘trading consumers’ are highly significantly different from the marginal rates of substitution of ‘trading citizens’ ($p = 0.000$).

The Mixed Logit (ML) model (Revelt and Train, 1998) resolves several of the limitations of the MNL model. By mixing the independent and identically distributed error with one or more additional random parameters, ML models are highly flexible: they can accommodate for random taste variation, unrestricted substitution patterns, and correlation in unobserved factors over time (Train 2009). As such, ML models have become the model of choice for many researchers conducting discrete choice analysis.

To analyze the distribution of the marginal rate of substitution we adopted a Random Valuation approach. This enables us to estimate the distribution of the marginal rate of substitution directly. A crucial aspect when estimating Mixed Logit models is the choice of the distribution of the random parameters. Fosgerau (2006) shows that the implied mean marginal rate of substitution can be highly dependent on the analyst’s choice of distribution. Therefore, we tested several distributions for both taste parameters, such as the lognormal, asymmetric triangular and Johnson SB distribution. Note that we restricted ourselves to one-side bounded distributions as it is behaviorally unlikely to have positive tastes for either more traffic causalities or longer travel time, at least in the range of travel times we explore. The Johnson SB distributions suffered from identification problems on several data sets. The statistically best results were obtained using an asymmetric triangular distribution. For reasons of conciseness we limit our discussion to the results for this type of distributions. Table 6 presents the estimation results and Figure 8 displays the distributions of the marginal rate of substitution of the respondents participating in experiments 2-4.

TABLE 6: Estimation results ML experiments 2-4 Trading Car Users only

Experiment	Experiment 2 Consumer route choice (no costs)			Experiment 3 Citizen route choice			Experiment 4 Citizen policy options		
# Observations	756			552			792		
Null LL :	-864.4			-382.6			-989.1		
Final LL:	-322.2			-209.32			-452.9		
ρ^2 :	0.61			0.54			0.54		
Estimates	Est	SE	T	Est	SE	T	Est	SE	T
Lower Bound	0.370	0.032	11.77	0.270	0.030	8.91	0.145	0.018	8.24
Upper Bound	7.770	0.833	9.33	8.490	1.710	4.98	5.480	2.510	2.18
Mode	0.509	0.492	1.03	4.100	1.500	2.74	5.370	2.510	2.14
Mean marginal rate of substitution B_Death/B_Travel Time	**2.88**			**4.29**			**3.67**		

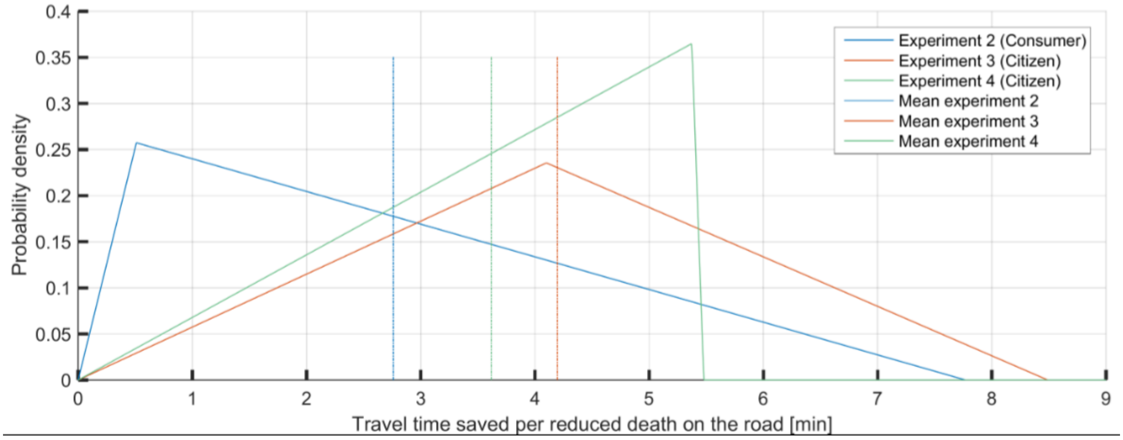

FIGURE 8 Distribution marginal rates of substitution between deaths and travel time experiments 2-4

Based on Table 6 and Figure 8 a number of observations can be made. Firstly, we see that signs of the estimates are in the a priori direction and we see that they are all highly significant. Secondly, the ML models considerably improve model fit on both data sets as compared to the MNL models. Furthermore, we see that the mean marginal rate of substitution parameter derived from the MNL and ML models are very close to one another. This stability in the outcomes testifies that these findings are not driven by the model specifications that are being used.

5.3. Citizen trade-offs between travel time and safety of whole sample

In sections 5.1 and 5.2 we excluded respondents participating in experiments 3 and 4 who filled out in the first part of the questionnaire that they did not drive a car more than two times a week. Excluding these respondents allowed us to make a fair comparison between the way in which people in their roles of both consumer and citizen trade-off travel time and safety, since only people who drive a car at least two times a week were able to participate in experiments 1 and 2. However, both the citizen preferences of car drivers and non-car drivers regarding trade-offs between travel time and safety can provide policy makers with relevant information. Hence, in this section, we analyze trade-offs between travel time and safety for the whole sample of respondents participating in experiments 3 and 4 (citizen experiments). Figure 8 presents for these experiments the share of respondents who choose for the safest route for offers differing in implied 'minutes per death' embedded in particular choice tasks (for both car drivers and the whole sample). Figure 9 reveals that only in experiment 4 the share of respondents choosing for the safest route in the whole sample is somewhat higher than the share of car drivers choosing for the safest route.

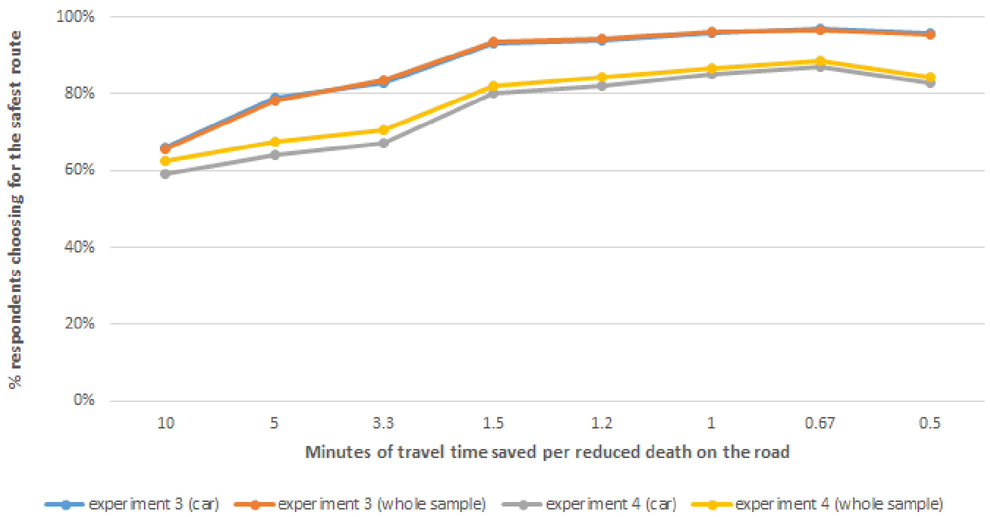

FIGURE 9 Percentage of respondents choosing for the safest route in experiments 3 and 4.

The estimation results of Multinomial Logit (MNL) models presented in Table 7 echo the observation derived from Figure 8 that non-car drivers participating in experiment 4 have a higher mean marginal rate of substitution between travel time and traffic deaths on the road compared to car drivers participating in experiment 4.

TABLE 7: Estimation results MNL experiments 3 and 4 whole sample

Context	Experiment 3			Experiment 3			Experiment 4			Experiment 4		
	Citizen route choice			Citizen route choice			Citizen policy options			Citizen policy options		
Respondents	Car drivers			Whole sample			Car drivers			Whole sample		
# Observations	1343			1715			1427			1799		
Null LL :	-930.9			-1188.7			-989.1			-1246.9		
Final LL:	-426.3			-529.3			-735.6			-879.3		
ρ^2 :	0.54			0.56			0.26			0.29		
Estimates	Est	SE	T	Est	SE	T	Est	SE	T	Est	SE	T
B_Death	-0.832	0.049	-19.25	-0.853	0.049	-19.25	0.484	0.029	16.29	0.512	0.028	18.56
B_TravelTime	-0.051	0.015	-3.72	-0.052	0.015	-3.72	0.045	0.012	3.69	0.034	0.011	3.05
Mean marginal rate of substitution B_Death/B_Travel Time	**16.31**	4.350	3.75	**16.40**	4.226	3.88	**10.73**	2.490	4.30	**15.06**	4.355	3.46

B_Death = marginal utility of one additional traffic casualty on a road
B_Traveltime = marginal utility of one additional minute travel time

6. Conclusions and discussion

The main interest of our study was answering the research question: do individuals have different preferences when trading off travel time and safety as consumer and citizen? We conclude that individuals trade-off travel time and safety differently as consumer and citizen. People in their role as citizen assign more value to safety than travel time when compared to their consumer choices. In the consumer experiments relatively many respondents chose for 'the fastest route'. In the citizen experiments relatively many participants chose for the 'safest route'. Hence, our results provide empirical support for the argument of economic-philosophers that trade-offs individuals make between travel time and safety in their role of *consumers of mobility*, may be a poor proxy for how the same individuals in their role of *citizens* believe that the government should trade-off safety and travel time. Our results question the current practice in which the effects of government projects are analyzed in Cost-Benefit Analyses using consumer-based willingness to pay metrics such as VOSL and VOT. The most important policy implication of a shift from evaluating transport projects using consumer preferences to evaluating projects using citizen preferences would be that projects which improve safety are likely to be relatively more attractive from a societal point of view when compared to projects generating travel time savings. In the remainder of this section we raise further topics for discussion.

6.1. Explanations for disparity between consumer and citizen preferences

As our research indicates that individuals trade-off travel time and safety differently as consumers and citizens the question for an explanation of this finding emerges. What explains that individuals trade-off safety and travel time savings differently as consumer and citizen? We believe that there are at least three plausible explanations and recommend further research to scrutinize each explanation. Below, we discuss these three explanations.

The first possible explanation is the ‘distribution of responsibilities explanation’. This explanation postulates that the more an individual believes that it is a ‘core government responsibility’ to influence a characteristic of the road network the more value (s)he relatively assigns to influencing this characteristic as a citizen and the more an individual believes that s/he has an own responsibility to influence a characteristic of a trip the higher his/her consumer value. Hence, in case an individual believes that the government has a relatively high responsibility concerning the safety of the road network when compared to the speed of the road network and this individual, at the same time, thinks that the population (including himself/herself) has a relatively high responsibility regarding the speed of his/her trip as a car driver when compared to the safety of the trip, it is expected that s/he assigns more value to safety than travel time as citizen than as consumer. This explanation also corroborates the results of Lindjhem et al. (2011) and Svensson and Johansson (2010) who found that consumer willingness to pay for public projects (e.g. a road improvement) reducing the risk of premature death is lower than the consumer willingness to pay for private products (e.g. a safety device in the car) resulting in a similar risk reduction. Consumers might be hesitant with stating or revealing a high willingness to pay from their after tax income for a public project improving road safety, when they think this is a core government task which should be funded with conventional taxes. In this case their citizen value for public investments in road safety might be high even though their consumer value is low.

The second explanation is Ackerman and Heinzerling’s (2002) ‘atomistic-holistic approach explanation’. They argue that in theory the atomistic approach, in which all individuals evaluate the relatively tiny impacts from a policy they themselves experience, should produce the same results as the holistic approach, in which all individuals evaluate the policy’s overall impact on the population. However, the authors postulate that it is plausible that in practice the atomistic and holistic approach provide different answers, since in the holistic approach individuals are put in the position of an ethical observer who realizes that it is likely that people will actually die when the policy is implemented, whereas in the atomistic approach individuals are only presented with – what Ackerman and Heinzerling call – “meaningless figures” such as ‘as a result of this policy you will have a 1/10,000,000 lower chance of dying’. The second part of Ackerman and Heinzerling’s (2002) argument consists of a postulation that the holistic approach forces individuals into a position in which they are likely to assign a higher value to non-market goods with a ‘sacred value’ such as a human life (they also mention ‘nature’ and ‘health’ as examples of such non-market goods). Theoretical economists will articulate this part of Ackerman and Heinzerling’s (2002) argument by stating that individuals’ private utility functions do not align with their social welfare functions (e.g.

Nyborg, 2000). That is, their judgment as Homo Politicus differs from their judgment as Homo Economicus.

We call the third explanation the 'controllability explanation'. In the literature (e.g. Dekker et al. 2011; Revesz, 1999; Rowlatt et al. 1998; Slovic, 1987), there is substantial evidence that individuals' willingness to pay for reductions in mortality risk that is perceived as less controllable (e.g. air pollution) is higher than individuals' willingness to pay for reductions in mortality risk that is perceived as relatively controllable (e.g. road safety). Moreover, researchers have found that individuals feel more justified in allocating public funds to reduce exposures of hazard that individuals themselves cannot otherwise control (e.g. Boswarth et al., 2010). In the pilot surveys especially male participants argued that they didn't attribute a lot of value to the 'number of deaths on the road per year' in the consumer experiments because they were confident about their driving skills. Hence, because these respondents felt 'in control' they assigned a relatively low value to safety. It is plausible to assume that respondents participating in the citizen experiments had the feeling that the risks they had to trade-off in the experiment were not (or only to a limited extent) controllable. If a respondent recommended the government to choose for a policy option which saves 1 traffic death per year instead of a policy option which saves 3 deaths per year it is plausible to assume that the respondent had in mind that the 2 traffic deaths (s)he implicitly accepted are not (or only to a limited extent) controllable for car drivers. Further research may investigate the validity of the three possible explanations discussed above and probably come up with alternative explanations.

A related avenue for further research is scrutinizing the explanation of the disparity between the results of the two citizen experiments (citizen route choice, experiment 3; citizen policy options, experiment 4). Particularly car drivers assigned relatively many value to safety when recommending the government about a route choice when compared to their recommendation of a policy option. A possible explanation is that respondents perceive a route choice of the government as more irreversible than the choice of the government between policy options.

6.2. Incorporating the results in evaluation framework

The results of this study raise the question how the inferred citizen preferences can be incorporated in evaluation frameworks for transport projects. Hence, further research may study how citizen preferences can be incorporated in evaluation frameworks for transport projects. For instance, the following research questions may be studied: To which extent is it possible to translate citizen preferences directly into conventional evaluation frameworks such as a Cost-Benefit Analysis? How to evaluate government policies which result in a variety of effects from a citizen perspective? How to evaluate projects that are partly financed by private investment companies and partly with conventional taxes? How to avoid double counting when accommodating people's altruistic concern for others' safety and travel time in an evaluation framework (e.g. Bergstrom, 1982; Jones-Lee, 1991)? For the period of time in which such questions are not answered and it is not clear how citizen preferences should be integrated into an evaluation framework, we recommend to compare the calculations of consumer-based evaluations such as CBA with the results of citizen experiments when a government project financed from conventional taxes is evaluated. If conventional CBAs and calculations based on citizen preferences provide ambiguous policy recommendations, we recommend to communicate this to policy makers.

6.3 Further empirical research

In addition to the topics addressed above we think that there are several other interesting avenues for further empirical research regarding the extent to which individuals trade-off effects accruing from transport projects differently as consumer and citizen. Firstly, we believe it would be interesting to replicate this particular study in other countries. Possibly, in other countries than the Netherlands citizens might believe that their government is endowed with relatively less responsibility concerning the safety of the road system which, in turn, might lead to smaller deviations between consumer and citizen preferences. For instance, this might be the case in countries were the government is relatively small and transport infrastructure is to a limited extent state owned. Secondly, it might be interesting to repeat the experiments for a real life transport project and see whether this will lead to different results. Moreover, further research may study the extent to which users of other modes (e.g. public transport users and cyclists) make a different trade-off between travel time and safety as consumer and citizen. Perhaps, the difference between citizens and consumers values for public transport safety is smaller than for car drivers, since public transport users cannot control/influence safety as much as car drivers. Another interesting direction for further research is scrutinizing how individuals trade-off other effects accruing from transport projects than safety and travel time savings as consumer and citizen. For instance, it might be interesting to analyze whether individuals trade-off two 'non-sacred' effects – such as comfort and travel time – similarly as consumer and citizen.

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