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Participatory Value Evaluation: a novel method to evaluate future urban mobility investments

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Abstract

Cost-Benefit Analysis (CBA) is a widely applied economic appraisal tool to support the planning and decision-making process for transport projects. However, in the planning literature CBA has been criticized for at least three reasons: 1) CBA focuses on traditional transport system related planning goals and poorly considers the broader goals of urban transport planning such as social equity; 2) CBA corrodes and degrades the forward looking nature of the planning proficiency. The instrument can be conceived as a backward looking methodology as it assumes that people's past decisions in a (private) market setting reflect their normative ideas regarding their preferred future urban mobility system; 3) CBA fails to recognize the specific (local) features of the problem which a transport project aspires to solve as practical CBA studies use generic price tags to value impacts of a transport project. Participatory Value Evaluation (PVE) is a novel evaluation approach specifically designed to overcome these criticisms while preserving the positive aspects that CBA brings to planning. This paper illustrates the PVE method with a case study on the evaluation of a transport investment scheme of the Transport Authority Amsterdam. In total 2,498 citizens participated in the PVE. We find that projects with the highest social value focus on safety and improvements for cyclists and pedestrians, whereas projects that focus on reducing travel times for car users have lower value. Moreover, we establish that PVE captures citizens' preferences towards broader goals of transport planning such as improving health and the environment, fostering city cycling as well as the inclusion of ethical considerations such as spatial equality. PVE also allows for the inclusion of citizens' normative ideas regarding their preferred future urban mobility system and local characteristics of the transport problem/solution.

1. Introduction

Cost-Benefit Analysis (CBA) is a widely applied economic appraisal tool to support the planning and decision-making process for transport projects in OECD countries (e.g. Asplund and Eliasson, 2016; Thomopoulos et al., 2009). In many Western countries it is obligatory to assess a transport project using a CBA when a project needs (co)funding from the National Government (Mackie et al., 2014). Attitudes of policy makers and politicians towards the use of CBA in the planning and evaluation of transport projects have been analyzed in various studies (e.g. Beukers et al., 2012; Mouter et al., 2013a; Mouter, 2017; Nyborg, 1998; Vigren and Ljungberg, 2018). Most of these studies find that attitudes of these actors are quite positive.

The literature distinguishes at least seven categories of positive features of CBA. First, CBA is based on a rigorous theoretical framework being welfare economics (e.g. Beria et al., 2012; Boadway and Bruce, 1984; Farrow and Toman, 1999). The principles of welfare economics provide CBA researchers and users with a very clear framework when reflecting on which impacts of policy measures should be included in a CBA, and how these impacts could be measured and monetized (Romijn and Renes, 2013). Second, CBA enhances the attention given to citizens' interests and preferences in the political process (Mouter, 2017). Two important value judgments underlying welfare economics and CBA are 'individualism' and 'non-paternalism' (Boadway and Bruce, 1984). In combination, these postulates assert that the welfare impacts of individual members of society resulting from the project form the basis for establishing the societal welfare effect (individualism) and individuals are conceived to be the best judge of their own welfare (non-paternalism). Because impacts for citizens – and not the interests of stakeholders, academics or policy makers – are the focal point of a CBA analysis, the instrument is also known as the 'tax payers only' model of representation at the political negotiation table (Mackie et al., 2014). Third, CBA informs politicians about the most important effects of a project, which results in better informed debates and decisions (Mouter, 2017). For instance, Dutch politicians regard CBA as a praiseworthy attempt to list all the effects of a project in a structured way (Mouter, 2017). Politicians think that this is advantageous because it can prevent them from forgetting to consider important consequences for citizens in the decision-making process. Fourth, CBA is considered to be a useful building block for forming an opinion regarding public projects because the method provides insights into the order of magnitude of the effects by an attempt to convert these effects into money equivalents. This provides guidance when making decisions (Mouter et al., 2013b, Mouter, 2017). Fifth, due to standardization and the fact that the final indicators of a CBA (e.g. the benefit-cost ratio or the net present value) communicate very clearly, CBA can make public projects comparable (Mouter et al., 2013b, Mouter, 2017). Sixth, civil servants use CBAs to optimize infrastructure projects in the early phases of the planning process (e.g. Eliasson and Lundberg, 2012; Hahn and Tetlock, 2008; Mouter et al., 2013a). Finally, CBA can act as a filter that prevents weak public projects proceeding very far through the planning process (Hahn and Tetlock, 2008; Mackie et al., 2014; Mouter, 2017).

Although policy makers agree that CBA must have a role in the appraisal process of (integrated) transport projects, Mouter et al. (2013a) find that spatial planners think that too much value is assigned to the results of a CBA in the decision-making process. The

skepticism of planners is rooted in various critiques on CBA that have been put forward in the (planning) literature.

The first critique is closely related to the broadening of goals of transportation planning in the last decades. Manaugh et al. (2015), for instance, observe that throughout most of the 20th century the goals of transportation were almost entirely mobility-based, with a focus on congestion reduction, travel time savings and safety improvements for motorists. In this era CBA was an adequate tool for the planning and evaluation of transport projects (Manaugh et al., 2015). However, prompted by concerns regarding climate change, social inequality and the scarcity of public space in urban areas, the focus of transportation planning shifted more and more to other goals, such as long-run sustainability, quality of life, social equity and promotion of green transportation in urban regions (e.g. Banister, 2008; Ferreira et al., 2012; Handy, 2008; Manaugh et al., 2015). Banister (2008), for instance, argues that in urban areas a much wider notion of the street has been created, as it is no longer only being considered as a road but also as a space where people meet. Therefore, nowadays, urban transport projects pursue both traditional effects (e.g. costs, travel time savings, safety and reduction of noise pollution) as well as a diverse set of non-traditional effects such as long-run sustainability, townscape, social inclusion, city image and improving the quality of urban spaces (e.g. De Bruijn and Veeneman, 2009; Hickman and Dean, 2018; Nicolaisen et al., 2017). However, several authors argue that CBA fails to appreciate many of these non-traditional effects as they are generally not included in the CBA, or are given marginal importance because they are not quantified or monetized (Beukers, 2015; Handy, 2008; Hickman and Dean, 2018; Nicolaisen et al., 2017). For instance, various scholars argue that CBAs for cycling projects have difficulty with including the impacts of a modal shift from car to bicycle such as the positive health impacts of increased physical activity and a reduction of road congestion and emissions, even though realizing these impacts are often a key goal of cycling projects (de Hartog et al., 2010; Heinen et al., 2015; Adam et al., in press; van Wee and Börjesson, 2015). Moreover, planning scholars asserts that goals of cycling policies such as improvement of urban quality, space efficiency, social inclusion, improved mobility for children and social interaction potential are often ignored in CBA (de Hartog et al., 2010; te Brömmelstroet et al., 2017; van Wee and Börjesson, 2015). Planning scholars argue that the weak position for such impacts in CBA fails to acknowledge the multifaceted planning priorities in urban transport infrastructure investments (Handy, 2008; Nicolaisen et al., 2017). Handy (2008) argues that the poor consideration of broader goals of transport planning in CBA is also problematic because this may lead planners and policy makers away from those goals. In her view, this could significantly impede the achievement of broader goals of transport planning such as quality of life and long-run sustainability. Banister (2008) even claims that transport planning is at a crisis point as it underestimates the key challenges facing urban planners.

The second, and strongly related, critique is that CBA corrodes and degrades the forward looking nature of the planning proficiency (e.g. Banister, 2008; Hajer and Pelzer, 2018; Handy, 2008). Banister (2008) asserts that transport planning requires clear, innovative and strategic thinking about city futures in terms of desirability, and the role that transport can (and should) play in achieving these objectives. Handy (2008) argues that the central goal of transport planning is defining the desired future for a place and then think about policies

which help to move a place towards that future. Hajer and Pelzer (2018) assert that planning and evaluation need to refocus from a tradition of 'expected futures' to an approach centering on 'desirable futures' and ways to get there. This notion of anticipating the (uncertain) future by setting goals goes beyond one of the core principles of CBA: 'consumer sovereignty'. Consumer sovereignty asserts that the value of impacts of government projects can be determined based on the amount of money that individuals are willing to pay for these impacts in a (hypothetical) market setting. For instance, various impacts of government projects (e.g. noise, air quality and recreational opportunities) are valued through so-called hedonic pricing studies which infer individuals' willingness to pay for these impacts from people's private decisions in the real estate or labor market. Hence, the implicit assumption is that individuals' *past* choices in these markets are a good proxy for their believes concerning a *future* mobility system. A second empirical approach to infer the value of impacts of transport projects such as travel time savings and safety improvements relies on (hypothetical) choice experiments of individuals in their role as consumer of mobility (traveler). In these experiments, they are asked to make a series of choices between routes or modes which differ in terms of travel time, safety and private travel costs (e.g., Abrantes and Wardman, 2011; Bahamonde-Birke et al., 2015; Batley et al., in press; Börjesson and Eliasson, 2014; Hensher et al., 2009; Jara-Díaz, 2007; Kouwenhoven et al., 2014). Based on these choices analysts estimate the amount of money that individuals are willing to pay for reductions in travel time and mortality risk – the Value of Time and the Value of Statistical Life – and these price tags are used to value time savings and risk reduction resulting from government projects. Börjesson and Eliasson (2012) also propose to derive health benefits from cycling projects from travelers' choices between the bike and relatively unhealthy modes such as the car. 'Consumer sovereignty' has been questioned by various scholars who argue that it is not an adequate principle for the evaluation of government projects as individuals' private decisions might not reflect their preferences towards public policies (e.g. Ackerman and Heinzerling, 2004; Hauer, 1994; Sagoff, 1988; Sen, 1995). For instance, Ackerman and Heinzerling (2004, p. 191) state: "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". The critique that individuals' private choices may not fully reflect how they want public policies to change is also known as the consumer-citizen duality (Alphonce et al., 2014; Mouter et al., 2018). Recent empirical evidence has established that individuals do indeed value impacts of transport projects differently in a consumer and a citizen role. Mouter et al. (2017a, 2018) establish that individuals assign comparatively more value to safety than travel time savings in their role as citizens than in their role as consumers. Scholars argue that an important reason for the consumer-citizen duality is that moral considerations might be more salient in the citizen context (Sagoff, 1988; Sunstein, 2005). Mouter et al. (2018) also empirically identify various normative explanations for the fact that individuals' belief that one's government should assign greater value to safety than individual drivers should be expected to. For instance, citizens think that governments have a duty of care concerning the safety of the transportation network. Hence, it is conceivable that experiments conducted in a so-called citizen context also enable individuals to include equity-related goals of planning in their decisions. The fact that conventional (consumer-based) CBAs have difficulty with considering normative ideas regarding a preferred urban mobility system in the analysis is

also criticized in the planning literature (Hickman and Dean, 2018; Nicolaisen et al., 2017). For instance, Nicolaisen et al. (2017) observe that policy makers' normative aspiration to reduce car traffic in the urban core through discouraging car use is ignored or not sufficiently reflected in a CBA even though this is their key rationale for championing projects such as Light Rapid Transit (LRT), removing roads/car lanes and lowering travel speed.

A third critique relates to the fact that CBAs generally use standardized transport models to establish the impacts of a transport project and transfer these impacts into monetary terms using generic price tags such as the 'Value of Time' and the 'Value of a Statistical Life'. The transport models do seldom operate on the detailed level necessary to accurately estimate impacts of specific transport projects (van Wee and Börjesson, 2015) and it is highly questionable whether applying generic price tags leads to correct valuations in specific contexts (Mouter et al., 2013b). Hence, planners argue that this approach is unrefined and fails to recognize the special (local) conditions of the problem which the transport project aspires to address (Beukers et al., 2012; Handy, 2008; Mouter et al., 2013b). This critique relates to the dichotomy between formal assessment and informal assessment (Pesch et al., 2017). Formal assessment methods include institutionally established methods, such as CBA and environmental impact assessment (EIA). Apart from these formal assessment trajectories, transport projects are also assessed by local citizens, local businesses and other actors that are not part of established institutions. This so-called informal assessment trajectory particularly focusses on the specific characteristics, needs and concerns of the local communities that are affected by the transport project and/or problem. In case the informal assessment provides new insights, this may lead to adaptations in the formal trajectory, which Pesch et al. (2017) refer to as 'backflowing'. However, problems can emerge when the formal assessment methods do not respond sufficiently to the values and concerns that emerge from the informal assessment (Cuppen et al., 2016; Rip, 1986). When local populations feel that their arguments and sentiments are excluded in the formal assessment this can give rise to protests and growing distrust of citizens (Pesch et al., 2017). In short, planners contest CBA's 'backflowing capacity' as its generic approach does not properly account for the insights of citizens regarding the specific characteristics of the problem/project at hand.

Several scholars assert, however, that the critique on CBA is of little use if no alternative evaluation approaches are put forward (Handy, 2008; Hickman and Dean, 2018). Multi-criteria analysis (MCA) potentially solves some of the critiques, but this method does not exhibit the all the positive features of CBA addressed above (e.g. Beria et al., 2012; Annema et al., 2015). For instance, CBA outperforms MCA on its rigorous theoretical framework, the fact that CBA's final indicators communicate very clearly and CBA's potential to be used for optimization of public policies (e.g. Beria et al., 2012; Mouter et al., 2013a).

To our knowledge, no viable alternative for CBA has been put forward which has the potential to overcome the above mentioned critiques on CBA and, at the same time, exhibits the seven positive features of CBA. This paper introduces Participatory Value Evaluation (PVE) which is a novel evaluation approach specifically designed to overcome criticisms raised against conventional CBA while preserving the positive aspects that CBA brings to planning. In a PVE, citizens are asked to choose the best portfolio of transport projects with corresponding impacts for society and themselves given one or more constraints, such as a

limited public budget (Mouter et al., 2019). These individual choices are included in behavioral choice models that form the basis for the (economic) evaluation of policies (Dekker et al., 2019). This can be done through the elicitation of individuals' preferences over the allocation of public budgets ('citizen sovereignty') as well as their private income ('consumer sovereignty'). Hence, one important innovation of PVE is that the method goes beyond the paradigm of 'consumer sovereignty' that is adopted in a conventional CBA (Mouter et al., 2019). PVE is a non-paternalistic assessment methodology as participants are not urged to take a certain perspective or standpoint when selecting their preferred portfolio of public projects. They are free to adopt a purely self-interested perspective, but they can also select projects that line up with their preferred future perspectives regarding the (local) urban mobility system. Moreover, participants can decide themselves on the extent to which they select their preferred portfolio based on traditional impacts of the projects, broader goals of transport planning, ethical considerations or their personal experience of a transport issue. Furthermore, in order to avoid forced decision making, participants can delegate their decision to an expert if they do not want to decide.

The primary goal of our paper is to illustrate the PVE method with a case study on a transport investment scheme of the Transport Authority Amsterdam (henceforth: TAA). In this case study, four PVE-experiments were conducted in which citizens were asked to select their optimal portfolio of projects given a governmental budget constraint of 100 million euros (in two experiments respondents were also allowed to change the public budget). In total 2,498 respondents participated in the experiments. Importantly, respondents were asked to provide written motivations for each project they selected after they submitted their preferred portfolio. The second goal of the paper is to analyze these written motivations in order to investigate the extent to which PVE is able to capture broader goals of urban transport planning, citizens' normative ideas regarding their preferred future urban mobility system and local characteristics of the transport problem/solution. Section 2 describes the case study. Sections 3 and 4 discuss the descriptive and quantitative results of the PVE. Section 5 addresses the qualitative motivations provided by the respondents and, finally, section 6 discusses the results.

2. Case study: four PVEs for the Transport Authority Amsterdam

In this case study, four PVE experiments were conducted. Two 'fixed budget PVEs' in which citizens were asked to select an optimal portfolio of projects given a governmental budget constraint of 100 million euros. Any remaining budget was shifted forward to the next year. Moreover, two 'flexible budget PVEs' were conducted in which citizens could adjust the governmental budget by increasing the tax per household or by selecting a rebate. These experiments give an indication whether the budget currently allocated is at the right level. In the PVEs, respondents could choose between 16 projects such as improvements of cycling lanes, roads or public transport and solutions for safety issues. The total costs of the 16 projects was 405 million euros so it was not possible for the respondents to include all projects in their portfolio. We ensured that the projects were to some extend distributed between modes and the different regions that fall under the jurisdiction of the TAA (Figure 1 shows the locations of the projects).

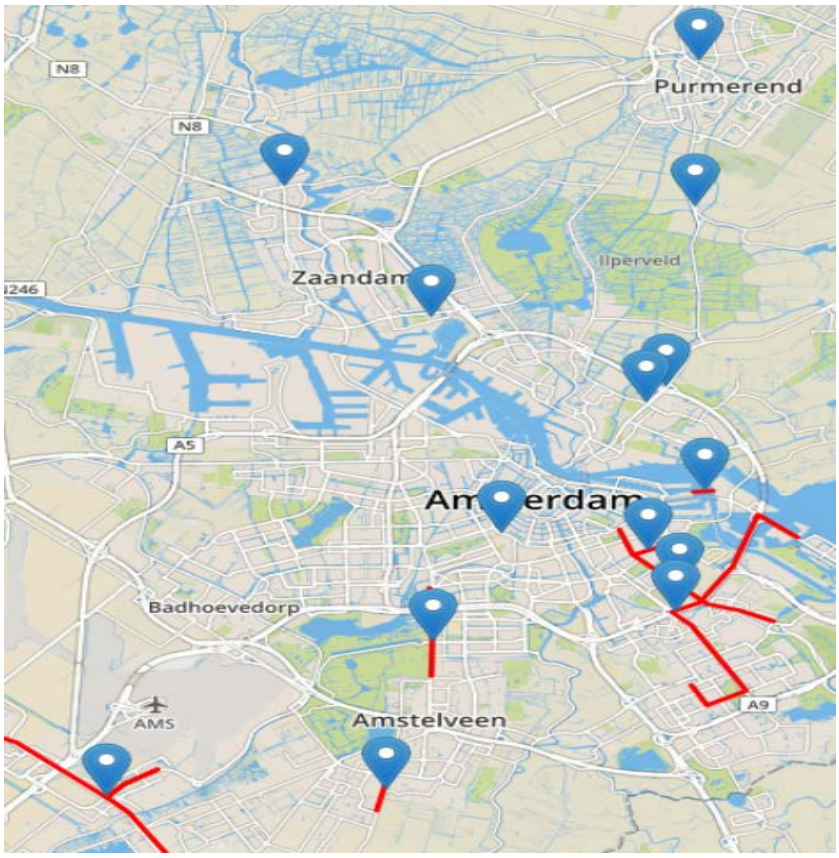

Figure 1: locations of 14 out of 16 projects. 2 projects ('traffic education' and 'five police officers are not attached to a specific location)

All experiments were conducted in a web-based environment. In this environment, respondents could sort and compare the projects by one of the impacts, and find out more about the (impacts of) projects through clicking on an information button. All projects are characterized by the societal impacts that CBA analysts from the TAA would consider in their analysis: costs, travel time savings, prevention of traffic deaths, prevention of severe injuries, number of households affected by noise pollution and number of trees cut. On top of that, a verbal description of the project and goals the project needed to achieve were provided. These verbal descriptions can be found in the demo version which can be accessed through: http://pve.splicedgene.com/participatory-value-evaluation-transport-authority-amsterdam

We used the project descriptions of the TAA to compose the verbal descriptions of the projects in the webtool. Interestingly, most of these project descriptions did not contain any information with respect to broader planning goals (e.g. sustainability, promoting green transport, equity, spatial quality). As addressed in the previous section, PVE is a non-paternalistic assessment methodology which means that participants are free to base their decision on the information provided in the PVE or information that is not included.

In all experiments participants were not forced to make a choice, but had the option to delegate their choice to an expert. In case respondents delegated their choice, they received a lower financial compensation from the survey company. The delegates in turn also conducted the experiment. When citizens delegated their choice, the choice of the selected delegate was used for the analysis. In total 2,498 respondents participated in the experiments.

After respondents made a portfolio choice, they were asked to explain each of their choices. A large group of respondents took the time to (thoroughly) motivate their choices. Respondents could also mention multiple motivations. The written motivations were manually coded in two rounds. The goal of the first round was identifying categories of motivations categories which resulted in 85 categories. In the second round, the 9,920 motivations were divided across these categories. Statements which could not be attributed to a specific category such as 'this project is an improvement' were ignored in the analysis of the qualitative data.

3. Descriptive results

Around 15% of the respondents delegated their choice. Table 1 presents the number of projects selected by the respondents. Table 1 shows that most respondents selected 3 or 4 projects.

Table 1: Number of projects selected by respondents

Number of projects selected	Number of respondents
0	35
1	42
2	181
3	475
4	479
5	362
6	285
7	216
8	127
9	23
10	1
11	1

Figure 2 presents the market shares of the different projects for the other 85% of the sample. For each project the average costs (in million euros) are displayed between brackets.

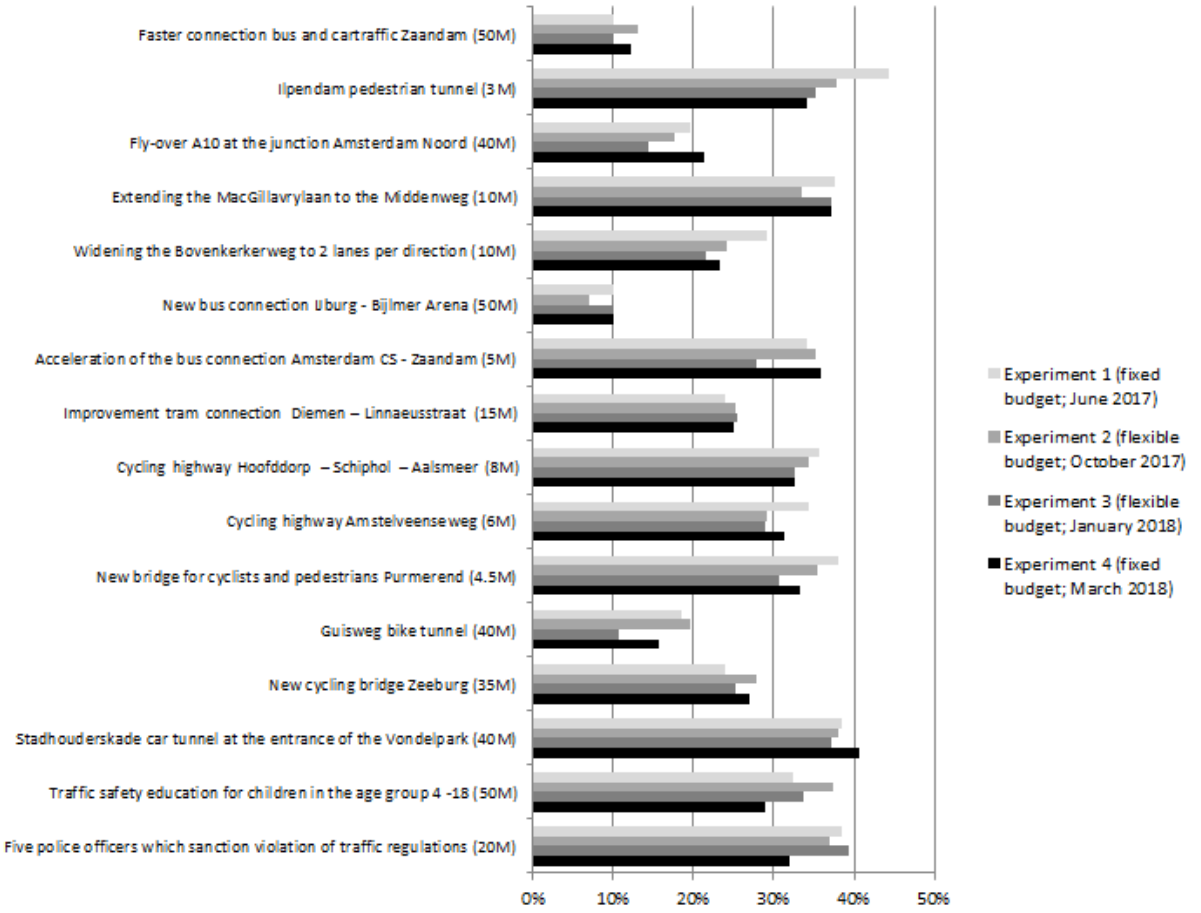

Figure 2: Percentage of respondents which selected the different transport projects

The first observation is that all projects are chosen with a market share above 5%. This is good news for the TAA as the choice set did not seem to include irrelevant projects (from the perspective of the citizens). Second, 12 out of 16 projects have a market share of more than 20% in all experiments which means that these projects are included in the portfolio by at least one fifth of the respondents. Third, Figure 2 shows that the differences in market shares between the four experiments are not very large. As the experiments took place at different time instances this is an indication that citizens' preferences for the 16 transport projects are fairly stable over time. Table 2 provides information about the socio-demographic characteristics of the respondents as well as their political affiliation.

Table 2: Socio-demographic characteristics of participants in the PVEs.

	Experiment 1	Experiment 2	Experiment 3	Experiment 4
Number of respondents	742	803	381	301
Gender				
Female	44%	47%	53%	50%
Male	56%	53%	47%	50%
Age				
18 - 25	4%	5%	12%	11%
26 - 35	10%	11%	13%	20%
36 - 45	14%	16%	10%	16%
46 - 66	23%	23%	19%	18%
56 - 65	22%	22%	24%	16%
65 +	27%	23%	22%	18%
Education				
Lower education	35%	35%	30%	37%
Higher education	43%	43%	47%	42%
University (of applied sciences)	21%	22%	24%	21%
Household gross income				
Less than 15,000	6%	6%	15%	8%
15,000 - 30,000	15%	14%	28%	12%
30,000 - 60,000	40%	40%	41%	38%
More than 60,000	39%	40%	16%	42%
Voted previous election				
VVD (Conservative-Liberal)	20%	24%	13%	18%
PVV, Forum for Democracy (Nationalists)	8%	7%	7%	6%
CDA, CU, SGP (Christian)	10%	8%	6%	9%
D66 (Social-Liberal)	14%	14%	17%	15%
GL, PvdD (Green Parties)	22%	22%	23%	21%
SP (Socialist)	11%	10%	14%	10%
PVDA (Labor)	11%	12%	8%	8%
I didn't vote	4%	3%	11%	11%

Table 2 shows that all segments of the population of the TAA are to some extent represented among the participants of the PVEs. Interestingly, also citizens who didn't vote in the most recent elections participated in the PVEs. Participants were also asked to evaluate the PVE on four items. Table 3 presents the results.

Table 3: Answers of respondents to the four items rated at the end of the PVE

	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
I was convinced of my choices	572 (32%)	991 (56%)	182 (10%)	22 (1%)	1 (0%)
I thought that the experiment was realistic	397 (22%)	907 (51%)	386 (22%)	87 (5%)	10 (1%)
I think it is good that the government aims to involve citizens in making choices between transport projects	1024 (56%)	687 (38%)	85 (5%)	20 (1%)	2 (0%)
This experiment provides the government with relevant information for making choices between transport projects	561 (31%)	908 (50%)	290 (16%)	56 (3%)	10 (1%)

Table 3 shows that 88% of the respondents were convinced about their choice and 73% consider the experiment to be realistic. Interestingly, 94% of the respondents believed it is good that the TAA involves citizens in making choices between transport projects and 81% of the respondents agreed with the proposition: 'the experiment provides the government with relevant information in their decision-making process'. Only 10 respondents strongly disagreed with this proposition.

4. Quantitative results

Budget restrictions imply that not all public sector projects can be implemented and that policy makers have to make trade-offs when deciding on the project portfolio. Dekker et al. (2019) have combined economic theory with behavioural choice modelling to identify the attractiveness of individual projects, which in turn allows policy makers to rank possible project portfolios and identify the best project portfolio. This is the portfolio that provides the highest (expected) societal value for a given budget. All the details of the specific behavioural choice model and the identification of the portfolio with the highest societal value can be found in Dekker et al. (2019), below we only discuss the most important assumptions that are made in the analysis.

The societal value of individual projects is elicited from the choices of the participants in the PVE, where it is assumed that respondents aimed to select the portfolio that in their view represents the portfolio with the highest (societal) value. This value can potentially include the private benefits of the project, but also other-regarding considerations related to the impacts of the project on other citizens or future generations. Part of the attractiveness of an individual project is defined by its 'explicit' impacts: reducing travel time, the number of traffic deaths, the number of severe traffic injuries, the number of households affected by noise pollution or the number of trees that need to be chopped. Dekker et al. (2019) show how to estimate so-called taste parameters in order to estimate the societal value resulting from these explicit impacts. Because the (un)attractiveness of an individual project can also be defined by other considerations than the level of the five explicit impacts so-called project specific parameters are estimated. These parameters capture other properties that influence a project's (un)attractiveness which are not captured by the taste parameters. First, these project specific parameters capture the societal value resulting from other considerations than the five explicit impacts (such as the broader goals of transport discussed in the introduction). Second, when citizens derive societal value from the fact that a project influences one of the explicit impacts irrespective of *the extent to which* the impact is affected, this is also captured in the

project specific parameter. To illustrate this: when a participant selects a project because (s)he thinks that reducing traffic deaths is a governmental duty, this is captured in the project specific parameters. When the participant values the *number of* traffic deaths that are prevented as a result of the project as well, this is captured in the taste parameter for traffic deaths. Both the taste parameters and the project specific parameters are presented in Figure 3 in the column 'Estimate'. Using the taste parameters it is also possible to establish the relative importance of the different impacts. The column 't-value' depicts whether the parameter is significant at the 0.05 level (t-value higher than 1.96). For instance, we can infer from the results that Dutch citizens think that the reduction of 1 traffic death is as important as the reduction of 8.34 severe traffic injuries (1.5814 / 0.1896). All the project specific parameters and the taste parameters for traffic deaths and severe traffic injuries are significantly different from zero. Hence, the level of these safety impacts are considered to be relevant when citizens choose their portfolio of projects. The taste parameter for reduction of travel time is not significantly different from zero. This means that *the level of* travel time savings does not significantly affect the (un)attractiveness of a project. However, *the fact that* a project reduces travel times can still impact a project's (un)attractiveness. In this case, this is captured in the project specific parameters.

Estimation results	Estimate	T-value
Taste parameters		
B_Reduction of travel time (per 1,000,000 minutes)	0.4806	1.13
B_Additional traffic deaths	-1.5814	**-2.76**
B_Additonal traffic injuries	-0.1896	**-2.31**
B_Additional households affected by noise pollution (per 100)	-0.0619	-0.85
B_Additional trees cut (per 100)	-0.0882	-1.09
Project specific parameters		
B_Faster connection bus and car traffic Zaandam	6.5555	**65.28**
B_Ilpendam pedestrian tunnel	4.5549	**101.35**
B_Fly-over A10 at the junction Amsterdam Noord	6.6974	**38.09**
B_Extending the MacGillavrylaan to the Middenweg	5.5604	**53.77**
B_Widening the Bovenkerkerweg to 2 lanes per direction	5.3741	**71.39**
B_New bus connection IJburg - Bijlmer Arena	6.3883	**139.15**
B_Acceleration of the bus connection Amsterdam CS - Zaandam	4.9451	**118.33**
B_Improvement tram connection Diemen – Linnaeusstraat	5.7723	**134.40**
B_Cycling highway Hoofddorp – Schiphol – Aalsmeer	5.3959	**128.12**
B_Cycling highway Amstelveenseweg	5.0542	**74.96**
B_New bridge for cyclists and pedestrians Purmerend (Hoornselaan)	4.8378	**110.12**
B_Guisweg bike tunnel	6.5271	**149.09**
B_New cycling bridge Zeeburg	6.6641	**146.95**
B_Stadhouderskade car tunnel at the entrance of the Vondelpark	7.0658	**108.88**
B_Traffic safety education for children in the age group 4 -18	7.1350	**77.60**
B_Five police officers which sanction violation of traffic regulations	6.1875	**65.71**

Figure 3: Estimation results behavioural choice model

The obtained results can be used for ranking the portfolios starting from the democratic one-person-one-vote assumption (see Dekker et al., 2019 for a detailed discussion of conducting such a welfare analysis). The behavioral choice models allow for the derivation of the probability that a project improves societal value compared to shifting the money to the next period, i.e. whether societal benefits are higher than the costs. This is a key step in the policy evaluation since participants in the PVE always have the fallback option of not spending any money in case they think that all the projects are undesirable. More specifically, in case all the participants in the PVE would have selected the null portfolio (a portfolio without any projects) thereby recommending to shift the entire public budget to the next year, the probability that one of the projects improves societal value compared to shifting the money to the next period would be (very close to) 0%.

Figure 4 shows that seven projects have a probability higher than 50% to improve societal value. The Stadhouderskade car tunnel has a 56% probability to improve societal value compared to shifting budget to the next year. There are also some projects with a negative desirability. For instance, the new bus connection IJburg – Bijlmer Arena has a 31% probability to improve societal value compared to shifting budget to the next year.

Project	Project type	Project desirability	
Stadhouderskade car tunnel at the entrance of the Vondelpark (40M)	Safety	56%	✓
Ilpendam pedestrian tunnel (3M)	Safety	55%	✓
Traffic safety education for children in the age group 4 -18 (50M)	Safety	54%	✓
Five police officers which sanction violation of traffic regulations (20M)	Safety	54%	✓
New bridge for cyclists and pedestrians Purmerend (4.5M)	Slow modes	52%	✓
Extending the MacGillavrylaan to the Middenweg (10M)	Car	52%	✓
Acceleration of the bus connection Amsterdam CS - Zaandam (5M)	Bus	51%	✓
Cycling highway Hoofddorp – Schiphol – Aalsmeer (8M)	Bike	50%	?
Cycling highway Amstelveenseweg (6M)	Bike	48%	x
New cycling bridge Zeeburg (35M)	Bike	46%	x
Improvement tram connection Diemen – Linnaeusstraat (15m)	Tram	44%	x
Widening the Bovenkerkerweg to 2 lanes per direction (10M)	Car	44%	x
Fly-over A10 at the junction Amsterdam Noord (40M)	Car	41%	x
Guisweg bike tunnel (40M)	Bike	40%	x
Faster connection bus and cartraffic Zaandam (50M)	Bus / Car	35%	x
New bus connection IJburg - Bijlmer Arena (50M)	Bus	31%	x

Figure 4: Probability that a project improves societal value

Another noteworthy result is that the project desirability of the majority of the projects is very close to 50%. This reflects the high uncertainty associated with the policy recommendations.[1] The first cause for the high uncertainty is the tightness of the budget constraint in the experiment. For instance, many respondents included two very expensive projects in their portfolio ('Stadhouderskade car tunnel' and 'Traffic education for children') which already takes up 90% of the budget. From this selection we can infer that these respondents think that these two projects are highly attractive, but at the same time it is hard to evaluate how these respondents judge the attractiveness of the other 14 projects. A second explanation for the high uncertainty in the policy recommendations is that the large majority of projects is selected by a substantial part of the participants. More precisely, 12 out of 16 projects have a market share higher than 20% in all experiments (see Figure 2 in section 3). In the presence of such conflicting preferences, it is relatively difficult to determine which projects have a negative societal value compared to a situation in which various projects were only selected by a few respondents.

The actual policy analysis works with central (expected) values of attractiveness to identify the optimal policy portfolio where each citizen receives the same weight. This indicates that the eight projects with a desirability probability of less than 50% should not be included in the optimal portfolio, irrespective of the available budget. At this stage we know which projects are attractive when the budget is unlimited, but policy makers are faced with limited budgets and PVE allows determining the best selection of projects (i.e. the best

[1] In a standard CBA such uncertainties are largely ignored due to working with average deterministic values.

portfolios) for a given budget. Figure 5 shows the top 10 of portfolios within a budget constraint of 100 million euros.[2]

Top 10 portfolio's	1	2	3	4	5	6	7	8	9	10
Faster connection bus and cartraffic Zaandam (50M)	0	0	0	0	0	0	0	0	0	0
Ilpendam pedestrian tunnel (3M)	1	0	1	1	0	0	0	1	0	0
Fly-over A10 at the junction Amsterdam Noord (40M)	0	0	0	0	0	0	0	0	0	0
Extending the MacGillavrylaan to the Middenweg (10M)	0	1	0	0	0	0	0	0	0	0
Widening the Bovenkerkerweg to 2 lanes per direction (10M)	0	0	0	0	0	0	0	0	0	0
New bus connection IJburg - Bijlmer Arena (50M)	0	0	0	0	0	0	0	0	0	0
Acceleration of the bus connection Amsterdam CS - Zaandam (5M)	0	0	1	0	1	0	1	0	0	0
Improvement tram connection Diemen – Linnaeusstraat (15m)	0	0	0	0	0	0	0	0	0	0
Cycling highway Hoofddorp – Schiphol – Aalsmeer (8M)	0	0	0	0	0	0	0	0	1	0
Cycling highway Amstelveenseweg (6M)	0	0	0	0	0	0	0	1	0	0
New bridge for cyclists and pedestrians Purmerend (Hoornselaan) (4.5M)	1	0	0	0	1	1	0	0	0	0
Guisweg bike tunnel (40M)	0	0	0	0	0	0	0	0	0	0
New cycling bridge Zeeburg (35M)	0	0	0	0	0	0	0	0	0	0
Stadhouderskade car tunnel at the entrance of the Vondelpark (40M)	1	1	1	1	1	1	1	1	1	1
Traffic safety education for children in the age group 4 -18 (50M)	1	1	1	1	1	1	1	1	1	1
Five police officers which sanction violation of traffic regulations (20M)	0	0	0	0	0	0	0	0	0	0
Total costs portfolio	**98**	**100**	**98**	**93**	**100**	**95**	**95**	**99**	**98**	**90**

Figure 5: 10 portfolio's which result in the highest expected societal value within budget constraint

The first conclusion that we can draw based on these results is that the optimal portfolio consists of the Ilpendam pedestrian tunnel, the new cycling bridge in Purmerend, the Stadhouderskade car tunnel and the traffic education program. These are all projects that focus on safety and improvements for cyclists and pedestrians. Road projects and public transport projects are not included in the best portfolio. Moreover, comparing the first-best portfolio (portfolio with the highest societal value) and the second-best portfolio, shows that it is not always the best option to spend the entire budget. Finally, the Stadhouderskade car tunnel and the traffic education program received high support by citizens and are included in all the top 10 portfolios within a budget constraint of 100 million euros. Citizens seem unwilling to sacrifice these projects for alternative projects.

5. Qualitative results

In order to analyze the extent to which participants included broader goals of urban transport planning in their portfolio selection, we clustered the 85 categories of stated motivations into four primary categories. The first category concerns motivations that fully align with the traditional goals of transport planning: improving safety, reducing travel time/congestion, preventing noise pollution and personal benefits/self-interest (henceforth: 'traditional goals').

[2] Here we used the average budget recommended in the two flexible budget experiments (100.03 million euros) as the budget constraint.

The second category consists of motivations that are closely related to the traditional goals: improving accessibility to the suburbs and improving the orderliness of the traffic situation. The third category consists of motivations that are related to broader goals of transport planning: improving health and the environment, improving the attractiveness of the area, promotion of public transport and cycling, reducing car traffic through substitution of modes and promoting equity considerations. The fourth category consists of other motivations.

Figure 6 provides for each project an overview of the motivations put forward by citizens. For reasons of readability, various small categories are excluded from Figure 6.[3] Figure 6 reveals that respondents clearly include various broader planning goals in their selection of projects. Particularly for the cycling projects it holds true that a relatively large share of motivations relate to broader planning goals. For instance, for the Zeeburg cycling bridge only 33% of the motivations refer to improving traffic safety and reducing travel times/congestion. Other motivations that respondents put forward for selecting this project were improving the accessibility of the suburbs (23%), the positive impact on health and the environment (8%), improving attractiveness and liveability of the area (3%), promoting cycling (21%) and reducing car traffic through mode substitution (11%). For the cycling highway Hoofddorp – Schiphol – Aalsmeer the results are even more pronounced. Only 25% of the motivations can be clustered in traditional transport goals and 71% of the motivations can be attributed to broader goals of transport (18% positive impact on health and the environment; 31% promoting cycling; 22% trying to get people out of their car). Figure 6 also shows that for some projects the majority of the motivations that were mentioned by respondents align with the traditional goals of transport. For instance, more than 90% of the motivations mentioned by respondents who selected the Ilpendam pedestrian tunnel could be clustered in the categories ‘improving traffic safety’ and ‘reducing travel time/congestion’. In the following sub-sections we discuss the four categories of motivations in a more detailed way, for instance, by illustrating the categories with representative statements of respondents. For reasons of succinctness we do not discuss all categories in this paper.

[3] Examples of such categories are: ‘trees should not be chopped’ (mentioned 30 times) and ‘this project perfectly aligns with other policies’ (mentioned 5 times).

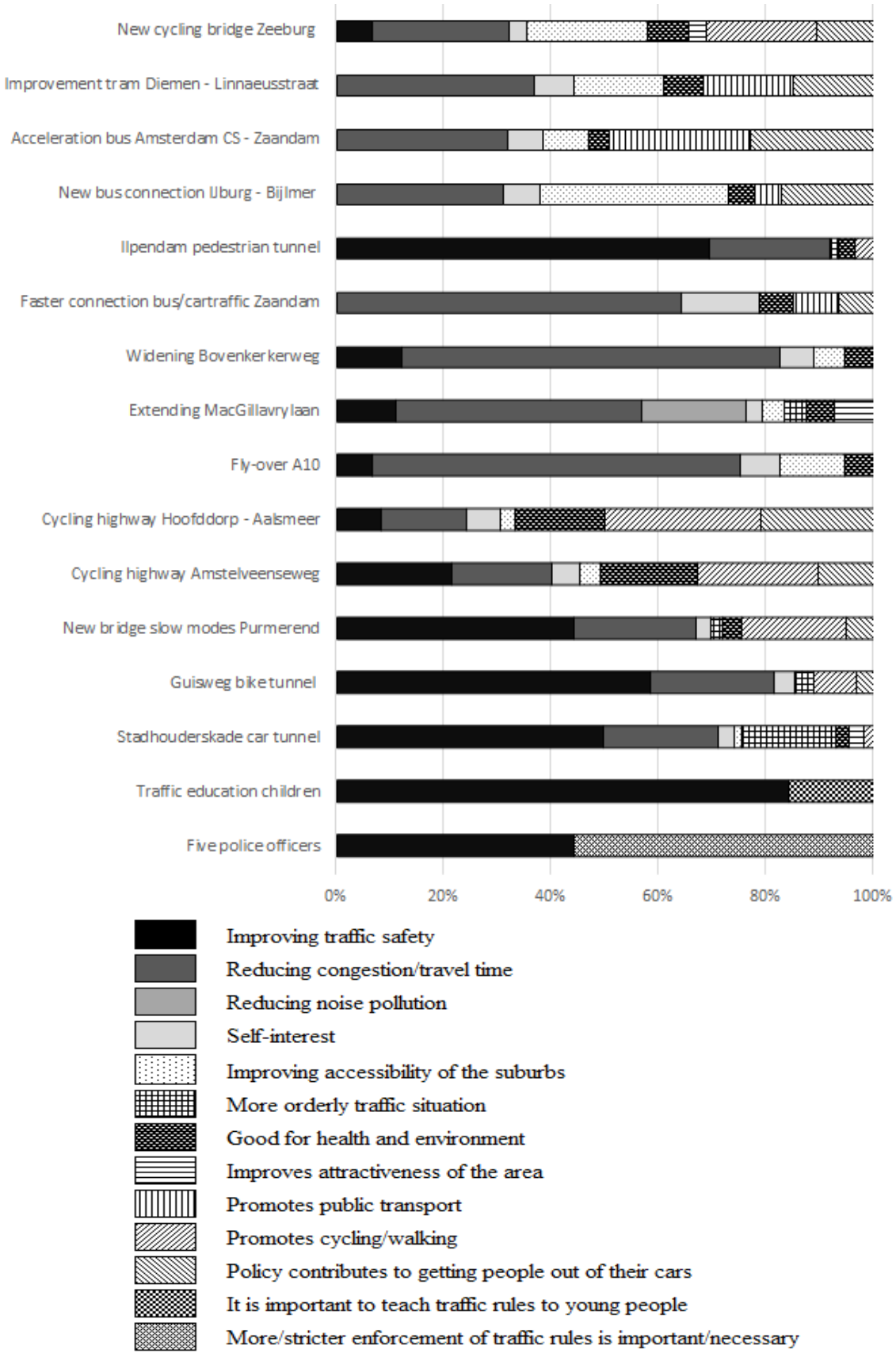

Figure 6: overview of qualitative motivations for each project

5.1 Traditional goals

Improvement of traffic safety was mentioned 2,502 times to underpin the selection of a project which makes this the most frequently cited motivation for choosing projects. Respondents are particularly likely to reference the traffic safety argument when the project is aimed at the protection of vulnerable travellers such as children, pedestrians, and cyclists. Particularly respondents motivate their choices for the Ilpendam pedestrian tunnel and the Guisweg bike tunnel in this way. For these two projects the qualitative statements uncovered specific characteristics of the safety issues that policy makers were unaware of prior to the completion of the PVE. This illustrates that in case citizens possess local knowledge that is difficult for officials or outsiders to acquire, PVE could be used for getting a better picture of transport problems through mobilizing such local knowledge (Fung, 2003). Below, we discuss the specific safety issues which the projects aim to solve through some illustrative statements.

5.1.1 Ilpendam pedestrian tunnel

Based on the statements of the respondents we were able to establish that the specific problem in Ilpendam is that pedestrians need to cross a busy road when they wish to access the bus stop. Currently, some pedestrians decide to disrespect the red traffic lights when they see that the only way to catch their bus is running through the red light. This results in very dangerous situations. Figure 7 shows the traffic situation in more detail.

Figure 7: Image retrieved from Google maps (July 2016) to illustrate the safety situation at Ilpendam.

Particularly the following statements clearly illustrate the specific safety issue in Ilpendam.

> *"The situation in Ilpendam is quite dangerous at present (certainly in the morning- and evening rush hours). Many pedestrians rush across even when the light is red – to catch the bus, for instance. A pedestrian tunnel would improve this dangerous situation."*

> *"Pedestrians just cross the street there right now, not at the crosswalk, not at a green light. They could get killed."*

"The intersecting road is quite busy and pedestrians regularly put their lives on the line to catch the bus."

5.1.2 Guisweg bike tunnel

The specific traffic safety problem at the Guisweg concerns the fact that cyclists sometimes have to wait a couple of minutes to cross the railroad. Some respondents reported about occasions in which they had to wait for 20 minutes. A clear problem is that particularly school children sometimes put their lives in danger by riding past the boom barriers to make sure that they are on time at school. Figure 8 shows the traffic situation in more detail. Subsequently, some illustrative statements are listed.

Figure 8: Image retrieved from Google maps (July 2017) to illustrate the safety issue at the Guisweg

"I know this crossing. It is a disaster. Dangerous and long waiting times. When several trains pass in a row you can wait there for minutes. Much longer than is described in the experiment. I think that this problem should be solved. For this reason, I think that this is a worthwhile investment. Moreover, I like the fact that no trees have to be chopped."

"With increasing rail traffic on the line to Alkmaar, level crossings are likely to be closed even more frequently. Cyclists and pedestrians in particular will probably cross illegally more than they do now (need/want to get to school on time)."

"The safety of cyclists played the largest role in motivating this decision. Because of the long wait times, cyclists occasionally decide to walk around the boom barriers

and, in doing so, put themselves in danger. This tunnel would prevent situations like these."

"I live in this area. The waiting time at traffic lights and rail crossings is incredibly long. Accidents still occur too often, including fatalities. People are also inclined to quickly ride past the boom barriers or through a red light! You can imagine how that turns out."

"Train machinists fear this intersection and therefore adjust their speed. It is not safe at this spot. Many school children and commuters. This traffic flow will only increase as the city of Amsterdam and its agglomeration are expanding."

The interesting part of the final statement is that it shows that PVE enables to mobilize the local knowledge of different types of citizens. Not only the perspectives of citizens who use or live close to the intersection but also the perspective of train machinists are included.

5.1.3 Near misses

Traditional CBAs generally operationalize traffic safety as the reduction in traffic deaths, serious injuries and slight injuries (Mackie et al., 2014). However, based on the statements of respondents we established that citizens' conceptualisations of traffic safety turn out to be broader than the reduction of injuries and deaths. Respondents argued that they also valued the reduction of small accidents, 'near misses' and the subjective experience of safety. The fact that travellers value both 'objective safety' and 'perceived safety' is endorsed in the literature (Adam et al., in press). Below, we present some illustrative statements provided by respondents who selected the Stadhouderskade car tunnel.

"I use this intersection on a frequent basis and I think it is very dangerous. The fact that various traffic flows cross each other results in near misses on a frequent basis."

"I am familiar with this place. Lots of tourists do not expect the trams when they cross the street. I have seen many near hits at this spot."

"Many small accidents occur at this intersection which are not registered."

"Because this is such a chaotic scene the speed is very low and there are not a lot of traffic deaths and injuries. But still a pedestrian tunnel is crucial to enhance travellers' sense of safety."

The final statement is particularly interesting because the respondent seems to believe that an improvement of subjective safety (preventing near misses) is important even though objective safety (reduction number of injuries and traffic deaths) is not affected that much.

5.1.4 Respondents use personal judgment to assess safety impacts

Several respondents stated that they selected a project for safety reasons even though we communicated to them in the experiment that the project would not have any safety impacts.

This was particularly the case for the cycling highway Amstelveenseweg project. The civil servants of the TAA that were involved in the design of the PVE were of the view that this project would not have any safety impacts. However, 23% of the motivations provided by the respondents related to safety improvements. For instance, one respondent made the following statement:

> "*I know this situation and think it is unsafe. Hence, I think that this problem should be tackled immediately.*"

Hence, we can conclude that respondents base their choices both on information that is offered to them in the experiment and personal experience.

5.2 Goals that are closely related to traditional goals

5.2.1 Improving the orderliness of a traffic situation

On 277 occasions, respondents indicated that they had selected a project because they believed it would make the traffic situation more orderly. Respondents characterized the present traffic situation as chaotic or stressful and hoped that the project would alleviate these issues thereby creating a calm, relaxed or pleasant travel experience. The fact that quite some respondents mentioned this motivation is remarkable because none of the project descriptions in the PVE contained any description which refers to improving orderliness or fostering a calm or relaxed travel experience (see: http://pve.splicedgene.com/participatory-value-evaluation-transport-authority-amsterdam for the project descriptions). Although it is questionable to which extent the orderliness of a traffic situation is already accounted for in a conventional CBA, we think that this motivation still closely relates to traditional goals such as travel time savings, safety, reducing congestion and particularly travel comfort. This motivation was primarily cited to explain choices for the Stadhouderskade car tunnel (18% of the motivations for this project referred to improving orderliness of the traffic situation). Below three illustrative statements are listed.

> *"I bike across this intersection quite often and pretty much always end up ringing my bell at someone. The bike path running along the Vondelpark is narrow, and there is an enormous number of tourists in this section who don't watch where they're going. If this ceases to be an intersection, and instead becomes two roads above/below each other, then cycling will become a lot more relaxed."*

> *"This is one of the most annoying spots in the city. Chaotic and dangerous. It would be very nice if some changes could be made here."*

> *"This place is a thorn in my side. Much too much traffic flows come together and for tourists it is impossible to understand the traffic situation. The tunnel would not only make this place much more safe but also more orderly."*

The Guisweg bike tunnel was another example of a project for which improving the orderliness of the traffic situation was considered to be an important motivation to select the project. See for instance the following statement.

> *"This is always a very busy crossing in terms of cyclists, and a strange one at that. People "swarm" around each other, making it a miracle that there aren't more accidents. A bike tunnel would allow a much calmer crossing for cyclists. It's not so much about the 2 minutes of time saved, but purely about the experience of cyclists."*

5.2.2 Accessibility of suburbs

On 408 occasions, respondents indicated they supported a project because it improved the accessibility of the suburbs of the city of Amsterdam. Based on an analysis of the statements that are clustered in this category we can conclude that citizens believe that improving accessibility has multiple goals. Various respondents claim that improving the connection between the city (centre) of Amsterdam and the suburbs eases the travelling between these two areas. This particular consequence of improved accessibility is included in a conventional CBA through travel time savings (e.g. van Wee and Börjesson, 2015). However, respondents also mentioned other positive consequences of improved accessibility which are not accounted for in conventional CBA. First of all, various respondents motivated their choice for the Zeeburg cycling bridge by arguing that this improved connection would remedy the isolation of the areas Zeeburg and IJburg thereby promoting social inclusion (e.g. van Wee and Börjesson, 2015). Various respondents claim that this bridge ensures that these neighbourhoods feel like being part of Amsterdam. Below we present some illustrative statements.

> *"This appears to be a small intervention, but the result will be that IJburg will become part of Amsterdam."*

> *"Zeeburg and IJburg don't feel like part of Amsterdam right now because it takes longer to get there. Better accessibility will improve the situation."*

> *"Provide IJburg with more and better connections to reduce its isolation."*

> *"At present, you have to make a ridiculous detour when you want to travel from Zeeburg to the city. For this reason, Zeeburg does not feel like being part of the city. The new bridge would rectify this issue."*

> *"It is important to improve the integration of Zeeburg and IJburg into the city centre and this is a perfect means to realize this aim."*

Respondents also frequently mentioned 'increased accessibility' as a motivation to underpin their selection of the acceleration of the bus connection between Amsterdam central station and Zaandam. Interestingly, the purpose of improving accessibility seemed to differ between this project and the new cycling bridge to Zeeburg. In the case of the accelerated bus

connection between Amsterdam central station and Zaandam, improving the accessibility of Zaandam seemed to be conceived as a solution to ameliorate the overheated real estate market in Amsterdam. Below, we present some statements which illustrate these fairness goals of the acceleration of the bus connection.

> "*A better connection between Zaandam and Amsterdam is necessary in my view because many people commute between those cities. This is particularly important because many people have to swerve to Zaandam because dwellings are now way too expensive in Amsterdam.*"

> "*This is good for the people whose daily lives are oriented towards Amsterdam, but who cannot afford a house in Amsterdam. This holds true for lots of families with small children.*"

> "*Zaandam and Amsterdam need to be better connected to alleviate the pressure on the real estate market. A better accessibility of Zaandam will encourage people to emigrate to this place.*"

5.3 Broader goals

5.3.1 The project increases the attractiveness of the area (spatial quality)

A first example of a broader transport goal that 118 respondents highlighted to motivate their choices in the PVE is that a project improves the attractiveness of an area. This argument is primarily cited by respondents who selected the Stadhouderskade car tunnel project. Interestingly, the description of this project in the PVE did not mention 'improving attractiveness' as a project goal. Below, we provide some illustrative statements.

> *"What a nice plan. It's such a beautiful piece of the city that gets intersected by a sort of highway. So many pedestrians crossing. Tunneling would make it a wonderfully quiet area in which the gate leading into the Vondelpark becomes a proper entrance."*

> *"The Stadhouderskade is very busy, so a tunnel will improve the landscape above ground."*

> *"By doing this, the Vondelpark will connect better with the walking area around the Leidseplein and people will experience more cohesion between the park and the rest of the city centre."*

> *"I know this place very well. This is a difficult traffic situation for all modes. The present-day chaos is not doing any justice to one of the most beautiful sites of Amsterdam"*

"This is an area which I would like to see dominated by cyclists and pedestrians to the greatest extent possible. A tunnel to take cars out of the picture is definitely something I approve of."

The last statement clearly reflects that the respondent has a certain desirable future in mind with respect to this location. PVE enables the inclusion of such preferences in the evaluation of urban transport projects.

5.3.2 Good for promoting cycling

As discussed earlier on in this section one of the most cited reasons for choosing one of the cycling projects is that respondents would like to promote cycling and believe that these projects could encourage citizens to cycle (coded 1,046 times). Particularly for the projects 'Cycling highway Hoofddorp – Schiphol - Aalsmeer' and 'Zeeburg cycling bridge' this is quite surprising as 'promoting cycling' was not discussed as a goal of the project in the project descriptions that were included in the PVE. Moreover, it is interesting to note that the majority of the respondents did not provide any further reasons why they feel that cycling should be promoted. In case respondents provided further motivations they particularly mentioned that promoting cycling is a means to a specific end 'cycling is good for health and the environment' (274 times) and 'encouraging cycling contributes to the reduction of car traffic' (290 times). We clustered these reasons into two separate categories which will be addressed in sections 5.3.3 and 5.3.4. Other reasons that respondents provided to underpin their belief that cycling should be promoted are discussed below.

On the one hand, there are respondents who seem to believe that cycling is a desirable behaviour that should be stimulated by the government:

"This is an additional incentive to take the bicycle and it is also a reward for cyclists." (Motivation for the Guisweg bike tunnel).

"Those who bike deserve a comfortable route." (Motivation for the Hoofddorp – Aalsmeer cycling highway)

Then there are respondents who feel that cycling is a part of the identity of Amsterdam itself. These respondents clearly have normative ideas regarding the urban mobility system of Amsterdam:

"My choices are based on the idea that Amsterdam is a cyclists city par excellence. This idea should be further developed and therefore we should encourage cycling by expanding cycling infrastructure." (Motivation for the Hoofddorp – Aalsmeer cycling highway)

One unique comment comes from a respondent who feels that cycling infrastructure should be improved in order to ensure that children learn to bike independently (to the sports club):

"Since more and more families today see both parents working, it is important that their children can get to the sports club by themselves during their "free" time. It is often the case that parents have to avoid making any commitments so they can get their kids to their sporting activities. If these children can safely bike along their "protected" routes, that reduces pressure on the parents and makes it less likely that someone has to "rush" home." (Motivation for the Cycling highway Amstelveenseweg)

Moreover, there are respondents who feel that there should now be more investment in cycling infrastructure for reasons of fairness. For instance, this could be because there has historically been much more money spent on the road network, or because proportionally less is done for cyclists and pedestrians as compared to drivers.

"There has been a lot of investment for drivers on the road network around Amsterdam. It's now time to consider the interests of cyclists and pedestrians." (Motivation for the Cycling highway Amstelveenseweg)

"It's nice that they're thinking about cyclists for once. This is why one would value this project more highly." (Motivation for the Hoofddorp – Aalsmeer cycling highway)

Finally, a number of respondents emphasize the importance of high quality cycling infrastructure because it is an inexpensive mode of transportation that is important to those who cannot afford to buy/use a car or use public transport.

"This is important for the cyclists who do not want to use public transport and can therefore save a bit of money by using their own bike to get around." (Motivation for the Cycling highway Amstelveenseweg)

5.3.3 Positive impacts on health and environment

In 274 occasions respondents argued that they selected a cycling project because of the project's positive impacts on health and the environment. This is a surprisingly high number because none of the project descriptions in the PVE discussed any health or environmental impacts. This motivation was particularly mentioned for underpinning choices of the two cycling highways (Amstelveenseweg; Hoofddorp – Schiphol – Aalsmer). Below we provide two illustrative statements.

"Promote environmentally friendly behaviour." (Motivation for the Hoofddorp – Aalsmeer cycling highway)

"When you compare cycling to car use, cycling is better for the environment and it is also a form of exercise. Hence, I support the projects that encourage cycling and project that improve safety for cyclists." (Motivation for the Guisweg bike tunnel).

5.3.4 Reduction of car traffic as a result of increase in cycling

In 290 of the explanations, respondents justified their choice for a cycling project based on their hope or expectation that the promotion of cycling would convince people to get out of their cars. This motivation is often mentioned in choosing for the cycling highway Hoofddorp - Aalsmeer. Again this high number of motivations is surprising considering that reducing car traffic is nowhere mentioned as a goal of one of the projects in the project descriptions.

> *"I think that a cycling city such as Amsterdam should always be promoting bike use, so that fewer people drive their car in the middle of the city." (Motivation for the Cycling highway Amstelveenseweg)*

> *"Amsterdam is a cycling city. I believe it should always be made easier for cyclists to move throughout the city so that people are less likely to drive to where they need to be." (Motivation for the Zeeburg cycling bridge)*

> *"Perhaps if you make a fast cycling route you'll be able to get a few people out of their cars. A few is already enough for me. If you don't do anything, absolutely nothing will happen." (Motivation for the Cycling highway Amstelveenseweg)*

Out of the sample responses provided above, the last one is of particular interest. This respondent suggested that simply getting a few drivers to opt for alternate means of transportation is enough to make the project worthwhile for him. Moreover, this respondent – like many other respondents mentioning this justification – did not provide any further explanation why discouraging car use is good.

5.3.5 Promoting other ethical considerations

49 respondents mentioned other ethical considerations than the ones addressed in the previous sections to underpin the selection of one of the projects in the PVE. The ethical considerations that was most mentioned involved the even distribution of traffic investments across the region. 27 respondents indicated that they had chosen a project because infrastructure should be improved across the region and not only in Amsterdam itself. These respondents therefore assign a value to a fair distribution amongst communities. This preference for spatial equality is a factor that is currently not considered in CBA (Mouter et al., 2017b). Below three statements are presented.

> *"As a resident of Amsterdam, I wanted to do something for the regions outside Amsterdam with the funds I had left over." (Motivation for the Ilpendam pedestrian tunnel)*

> *"I think that it is important that all regions notice some improvements" (Motivation new bridge for cyclists and pedestrians Purmerend).*

> *"Spread the investments across the region and across the different modes." (Motivation new bridge for cyclists and pedestrians Purmerend).*

Four respondents plead for infrastructure projects in the IJburg area because, according to them, political promises had once been made regarding them. These arguments relate to the ethical notion that it is important to keep promises:

> *"Absolutely necessary to make Zeeburgereiland and IJburg more accessible. This has been a particular annoyance of mine for years now, and most importantly it was an old promise made to the residents of IJburg. I don't live there myself, but I think that the situation is very bad at this moment" (Motivation for the Zeeburg cycling bridge)*

> *"IJburg is a politically neglected area where the original administrators made a lot of promises but, as usual, haven't actually seen many of them through. This may help the civil service to finally see past the ends of their noses." (Motivation for the new bus connection to IJburg)*

5.4 Other motivations

Apart from the motivations that could be linked to traditional or broader goals of transport planning, respondents also provided other (sometimes unexpected) justifications. This particularly holds for the two safety policies that were included in the PVE being the traffic safety education project and the project to add five additional police officers. The policy makers of the TAA expected a priori that respondents would only choose these projects to improve traffic safety, but respondents also provided other motivations. Because policy makers were a priori unaware of these motivations it is highly likely that these would be omitted into the valuation of these projects in a traditional CBA.

5.4.1 Traffic safety education for children

Concerning the traffic safety education project, 71 respondents indicated that they supported such an investment because they saw it as important to impart the rules of the road to young road users. At the same time, these respondents did not explicitly reference the improvement of traffic safety itself; those that did were classified under the 'traffic safety' category.

> *"Education is a matter of principle. You should always be investing in it."*

> *"The education, guidance, and shaping of our youth contributes to a more intelligent, engaged, and respectful society in the years to come."*

> *"I think that we can never do enough when it comes to education. It is vital to repeat the same message and maybe in the end people will become more tolerant."*

> *"Education of our children is crucial. This should always have the highest priority ."*

5.4.2 Five additional policy officers

Although the project to add five additional police officers which sanction violation of traffic regulations focused exclusively on traffic safety, 281 respondents indicated that they had chosen it because stricter enforcement of traffic laws is desirable in and of itself. Again, any

responses mentioning traffic safety as a reason for wanting stricter enforcement were classified under the 'traffic safety' category. It is notable that the number of respondents choosing this project for reasons of safety is lower than the number who chose it because they thought enforcement of traffic laws was valuable in its own right.

> *"Traffic violations are a big source of irritation for those who follow the rules. If you can see something being done about it, then that improves not only your sense of safety but also your own inclination to obey the rules of the road."*

> *"Always good to show the traffic jackasses that they can't get away with everything. Most importantly: fines on the spot!!! No sneaky photos with payment after the fact…"*

> *"I actually find 5 to be too few. There should be much more enforcement and more fines given out, particularly within cities."*

> *"It will be a good thing if more enforcement is applied to the exceedingly abundant traffic violations in Amsterdam, which – so it seems – are the most ordinary thing in the world."*

> *"It is about time to enforce the rules we made. Sometimes it feels that no one is obeying the rules. I know a lot of elderly people who do not cycle anymore because they are too afraid. This is madness of course."*

> *"I would not be surprized if better enforcement in traffic also results in positive impacts outside mobility because the essence is that people's inappropriate behaviour is reprimanded."*

> *"When you make rules you are obliged to enforce them."*

> *"I think that we have excellent traffic regulations. The problem is that these rules are not enforced."*

> *"The probability of being caught should increase. Traffic jackasses are annoying for everyone and this behaviour should not be rewarding."*

6. Conclusions and discussion

In the planning literature CBA has been criticized for at least three reasons: 1) CBA poorly considers the broader goals of urban transport planning such as social equity; 2) CBA corrodes and degrades the forward looking nature of the planning proficiency. 3) CBA fails to recognize the specific (local) features of the problem which a transport project aspires to solve. Participatory Value Evaluation (PVE) is a novel evaluation approach designed to overcome these criticisms while preserving the positive aspects that CBA brings to planning. This paper aims to introduces PVE and applies the method in a case study to explore the extent the critiques are actually circumvented. In the case study, 2,498 citizens were asked to

select their optimal portfolio of transport projects initiated by the Transport Authority Amsterdam given a governmental budget constraint of 100 million euros. Importantly, respondents were asked to motivate their choices for each project they selected after they submitted their preferred portfolio. We use these qualitative responses to explore the extent to which PVE is able to capture: 1) broader goals of urban transport planning; 2) citizens' normative ideas regarding their preferred future urban mobility system; 3) local characteristics of the transport problem/solution.

6.1 Main conclusions

First, we can conclude that PVE captures citizens' preferences towards broader planning goals in the evaluation of transport projects. Particularly for the cycling projects it holds true that a relatively large share of motivations relate to broader planning goals. For instance, for the cycling highway Hoofddorp – Schiphol – Aalsmeer 71% of the motivations can be attributed to broader goals of transport such as promoting cycling, trying to get people out of their car and improving health and the environment. The PVE also captures ethical considerations such as 'spatial equality' and 'keeping promises'. Second, PVE enables the inclusion of normative forward-looking preferences in the evaluation of transport projects.. The following statement of one of the participants in the PVE illustrates this clearly: *"this is an area which I would like to see dominated by cyclists and pedestrians to the greatest extent possible. A tunnel to take cars out of the picture is definitely something I approve of."* Third, PVE mobilizes local knowledge of a large group of citizens regarding the specific characteristics of the transport issue that the transport project aspires to solve. In a sense, PVE uses mass participation as a means to ensure that such local preferences are included in the economic evaluation. A similarity between CBA and PVE is that the impacts of a transport project are established based on standardized transport models. However, an important difference between the two methods is that a conventional CBA values impacts based on standardized price tags, whereas judgments of (local) citizens form the basis of the evaluation of impacts in a PVE. Citizens who participate in the PVE can decide for themselves on the extent to which they base the selection of their preferred portfolio on the social impacts for which they received explicit information in the PVE, on their personal experience with a transport issue(s) or on other considerations that may have been overlooked by experts and transport models. In essence, PVE can be conceived as a method which combines formal assessment and informal assessment (Pesch et al., 2017). The standard impacts computed by a transport model comprise the formal part of the assessment. The informal part of the assessment refers to the fact that PVE leaves room – and can be adapted to – the values and concerns of citizens that are not on the radar of policy makers and experts. Especially for the safety projects in the PVE it holds true that participants grounded their judgments in personal experiences that policy makers were unaware of prior to the completion of the PVE. For instance, participants argued that they selected a project because, in their view, a problem at this location is that school children put their lives in danger by riding past the railway crossing to make sure that they are on time at school. The policy to add five additional police officers is a good example of a selected project by citizens based on other motivations than the policy makers of the TAA expected a priori. Although the policy makers expected that citizens would only choose these projects to improve traffic safety, the most mentioned argument by respondents was that

they thought that a stricter enforcement of the traffic laws is desirable in and of itself. Because policy makers were a priori unaware of these motivations it is highly likely that these would be omitted into the valuation of these projects in a conventional CBA. Hence, a PVE can provide focused, and otherwise unavailable, information about citizen values, preferences and perspectives on the details of urban policy (Fung, 2003).

6.2 Participatory Value Evaluation versus Cost-Benefit Analysis

In the introduction we positioned PVE as a method which overcomes criticisms raised against conventional CBA while preserving the seven positive aspects that CBA brings to planning. Although the extent to which PVE exhibits these positive features to the same extent as CBA needs to be established empirically we will discuss the way PVE aims to preserve these seven aspects in Table 4.

Table 4: analysis of the extent to which positive features of CBA are preserved in PVE

Criterion	Positive feature CBA	How is the criterion preserved in PVE?
I	CBA is based on welfare economics which is a rigorous theoretical framework that takes into account preferences and budget constraints of individuals.	PVE is based on a rigorous behavioral choice modelling framework as well that takes into account private and public budget constraints (see Dekker et al., 2019).
II	CBA enhances the attention given to citizens' interests in the political process because impacts for citizens form the focal point of the analysis and the preferences of citizens are respected (non-paternalism).	Impacts for citizens also form the focal point of a PVE. PVE is a more non-paternalistic method than CBA as CBA restricts people's preferences to the preferences they reveal as a private individual in (hypothetical) market settings without their consent that these preferences can be used for the evaluation of public policies. It therefore can be argued that PVE outperforms CBA on this criterion.
III	CBA informs politicians about the most important effects of a project, which results in better informed debates and decisions.	PVE outperforms CBA on this criterion because mass participation of citizens ensures that local impacts which were not anticipated by civil servants can be included in the analysis.
IV	CBA is considered to be a useful building block for forming an opinion regarding a transport project because the method provides insight into the order of magnitude of the effects accruing from a project. These valuations can be applied in multiple contexts.	The taste parameters presented in Figure 3 also provide insights in the order of magnitude of effects accruing from a project, but it is yet unclear whether these taste parameters can be generalized.
V	CBA makes projects comparable.	PVE makes projects comparable as well. PVE outperforms CBA on this criterion because respondents directly compare projects in a PVE.
VI	CBA can be used to optimize for the design of infrastructure projects.	PVEs can be used to optimize project *portfolios* taking into account the governmental budget constraint. Through sensitivity analyses one can analyze the conditions under which a project becomes (un)desirable (see Dekker et al., 2019; Mouter et al., 2019).
VII	CBA can act as a filter to prevent positive decisions on weak projects.	A positive decision on a weak project can be prevented when a PVE shows that a project does not result in a positive societal value.

Table 4 reveals that CBA and PVE perform similarly on most of the criteria addressed. PVE outperforms CBA on three criteria and CBA outperforms PVE on one criterion. Again, we wish to emphasize that the analysis in Table 4 is not an empirical exercise but a methodological comparison.

Apart from providing innovations in terms of the evaluation of government projects, PVE also facilitates the participation of large groups of citizens in the design of public policies. Table 3 confirms that participants valued the fact that participating in the PVE made them feel involved in the decision-making process. PVE can also overcome issues that result from the fact that conventional approaches to citizen participation (e.g. public hearings, citizen juries) generally require a substantial time commitment which many citizens would prefer to avoid. This has the potential to lead to a poor representation of the general population, insofar as those with a high motivation to participate will be those that have the most to gain by influencing decisions, but also have the free time and economic resources to do so (e.g. Irvin and Stansbury, 2004; Day, 1997). Various studies find that in conventional participation approaches white, middle aged well-educated males are overrepresented (e.g. Huitema et al., 2007; Public Agenda, 2016; Wittmayer and Rach, 2016). A key benefit of PVE is that the entry barrier for participating is relatively low. Participants generally spend 20 minutes to submit their choice(s), and the respondents can choose themselves when and where they conduct the PVE. Hence, the probability is relatively high that a more representative part of the population participates. Our study indeed finds that all segments of the population are represented to a somewhat equal extent in a PVE (see Table 2 in section 3). We also found that a substantial number of citizens participated in the PVE who said that they didn't vote at the most recent elections.

Moreover, the use of PVE might contribute to citizens' acceptance of government decisions by recognizing two justice dimensions that play an important role in acceptance of government policies: distributive and procedural justice, (e.g. Jenkins et al., 2016; McCauley et al. 2013; Sovacool et al., 2016; Sovacool and Dworkin, 2015). The use of PVEs can secure or enhance distributional justice as citizens are explicitly asked to consider the distribution of burdens and benefits of transport projects and procedural justice because, when incorporated in the policy process, PVEs directly involve citizens in decision-making about transport projects. Moreover, the option in a PVE to provide qualitative motivations might be a vehicle for citizens to express their concerns and values. The importance of the active involvement of citizens in the decision-making process on transport schemes to secure high-quality implementation is also recognized in the transport literature (Banister, 2008; Handy, 2008). At the same time it should be noted that the introduction of PVE does not disregard the role of experts in urban mobility planning. First of all, experts have an important role in the design of the PVE-experiments. Second, citizens can delegate their choice to an expert. Moreover, in a recent PVE about water management policies (Darteé, 2018) citizens were asked which value should be assigned to the results of the PVE in the decision-making process. Interestingly, more than half of the respondents argued that the results of the PVE should not be decisive as the opinion of experts, civil servants and politicians should also count in the final decision. Hence, it can be argued that experts also have a third role on top of the design role and being an expert to whom participants can delegate.

Another potential virtue of PVE relates to communication/awareness raising. That is, citizens better understand the dilemmas public bodies are faced with in making complex decisions when participating in the PVE, because they have to make – consequential – choices themselves. For instance, citizens learn about scarcity of public resources (not everything is possible) and the cons and pros of the alternative policy options.

6.3 Further research

The most important conclusion of this study is that PVE resolves some of the key critiques of planners that a range of impacts and considerations is not captured in conventional CBA studies. An interesting avenue for further research concerns the extent to which it is also possible to capture these impacts in an 'ideal CBA study' in which all these impacts are valued using dedicated valuation studies. We think that there are two challenges for such an ideal CBA study. A first challenge concerns the incorporation of values, preferences and perspectives of citizens that policy makers and analysts are unaware of when conducting the study. Secondly, it is problematic – if not impossible – to appropriately value the range of normative beliefs towards public policy that were identified in the PVE through valuation methods such as revealed preference studies and hypothetical route choice experiments that rely on (hypothetical) private choices (Mouter et al., 2019). However, we do think that it is possible to value such considerations through contingent valuation experiments in which individuals are asked how much they are willing to pay for the implementation of a public project/policy. For instance, it is possible to ask people what they are willing to pay for a higher number of times that traffic rules are enforced, a more even distribution of traffic investments across the region or the fact that the municipality keeps promises that were made in the past. After conducting an ideal CBA study it would be highly interesting to compare the results with a PVE. Moreover, it would be interesting to compare the costs of conducting both studies. It is highly likely that the costs of an ideal CBA study would be substantially higher as for each impact a new study needs to be conducted, whereas PVE values all impacts and considerations in one single experiment.

Another highly important avenue for further research relates to the information provided to the participants in the PVE. A key result of our study is that respondents selected their preferred portfolio based on impacts and considerations for which they did not received any explicit and systematic information in the PVE. For instance, respondents argued that they selected cycling projects to promote cycling, to try to get people out of their car and to improve health and the environment. However, because respondents were not provided with any information they were forced to make arbitrary judgments which could result in overestimations or underestimations of these impacts (Carson, 2012; van Wee and Börjesson, 2015). One possible solution is to transform PVE into an iterative assessment method which starts with a first round in which a relatively small group of respondents conducts the PVE. After this initial PVE the new motivations to select projects put forward by participants are further explored and contrasted with the literature. For instance, in the case of the PVE of this paper, literature on the impact of cycling highways on mode shift from car to bicycle (e.g. Goodman et al., 2014; Heinen et al., 2015) and resulting impacts on health (e.g. de Hartog et al., 2010) would be explored. In addition, it would be interesting to interview respondents that mention new motivations. For instance, in the case of the PVE of this paper respondents who

argued that they selected cycling projects to reduce car use would be interviewed to identify their underlying motivation to pursue a reduction of car use. Subsequent to these investigations, the new information would be integrated into a final PVE in which a larger group of citizens participates. Another avenue for further research concerns experimenting with PVEs in which participants receive other types of information than project descriptions and quantitative information about the societal impacts of each project. For instance, Hajer and Pelzer (2018) assert that to engage with (a plurality of) possible futures, scientific knowledge should be presented in a truly new way; immersive and visual rather than on text and numbers in written down form. Hence, it might be interesting to inform participants in a PVE through sketches of the traffic situation before and after the project or to give participants the opportunity to watch a video in which a project leader or an affected citizen addresses the local traffic issue and the merits of the transport solution. Another interesting avenue for further research concerns the analysis of the written motivations. Manual analysis of these motivations is very arduous and would surpass human capacity when larger numbers of citizens will participate in PVEs. Hence it is interesting to investigate whether algorithms can be developed to analyse the written motivations automatically using computational linguistics (Vossen et al., 2016).

Moreover, further research may investigate the generalizability of the results of this specific PVE. First of all, it is questionable whether our finding that broader planning goals play an important role in the motivations of citizens is generalizable to the assessment of large infrastructure projects such as a new motorway. In addition, the fact that broader transport goals play a strong role in citizens' motivations for the selection of cycling projects might be a specific result for countries with an omnipresent cycling culture such as Denmark and the Netherlands, but these results might not be generalizable to car-oriented cities. Moreover, it would be interesting to explore the extent to which PVE is a fitting tool to establish the societal value of other types of transport policies such as policy measures to encourage citizens to buy electric vehicles, road pricing policies and investment schemes to adjust the transport system to the introduction of automated vehicles and Mobility as a Service. Finally, in future PVEs it might also be worthwhile to ask participants to select the project(s) that they do not want to see implemented and ask for their motivations. For instance, it might be possible that respondents who did not select the Stadhouderskade car tunnel project because they liked the chaos at this location. The option to 'vote against' projects in a PVE enables these citizens to express and motivate a potential negative preference.

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