Participatory Value Evaluation: a novel method to evaluate transport investments

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1. Introduction

In western countries, Cost-Benefit Analysis (CBA) is nowadays considered the gold standard for supporting public decision-making (Boardman et al., 2013). In virtually all western countries CBA is mandatory when national funding is required for large transport projects (Mackie et al., 2014). The theoretical foundations of CBA are rooted in welfare economics which is a branch of economics that investigates the social desirability of alternative economic outcomes (Boadway and Bruce, 1984). The CBA is built on the Kaldor-Hicks efficiency criterion (Boadway, 2006), which recommends projects where the monetary gains outweigh the monetary losses. Accordingly, winners should still be better off after (hypothetically) compensating the losers of government projects. In a CBA, positive and negative impacts of government projects are valued by estimating private willingness to pay (WTP) and by assuming that private preferences should be respected. This paradigm is called 'consumer sovereignty' (Boadway, 2006). The paradigm of consumer sovereignty is fiercely criticized in the literature (Ackerman and Heinzerling, 2004; Hauer, 1994; Sagoff, 1988). '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. (2017, 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.

Participatory Value Evaluation (PVE) is a novel evaluation approach specifically designed to overcome criticisms raised against consumer sovereignty (and also other criticisms regarding conventional CBA). The key distinction between the two methods is that CBA infers welfare effects of (government) projects from individuals' monetary willingness to pay in (hypothetical) markets, whereas PVE infers welfare effects from individuals' preferences over the allocation of (public) budgets. Hence, one important innovation of PVE is that 'consumer sovereignty' is replaced by 'citizen sovereignty'. In a

PVE, individuals are conceptualized as co-owners of the government instead of consumers of public goods. 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 limited budgets and sustainability goals. These individual choices are included in behavioral choice models that form the basis for the (economic) evaluation of policies (Dekker et al., 2019).

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

This paper illustrates 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. 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. 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.

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. In all experiments participants were not forced to make a choice, but had the option to delegate their choice to an expert. Finally, participants in a PVE are asked to motivate their choices for each project they selected. The qualitative statements can uncover impacts and considerations which drive citizens' preferences regarding a project, that policy makers were unaware of prior to the completion of the PVE.

3. Results

3.1 Descriptive results

In total 2,498 respondents participated in the experiments. Around 15% of the respondents delegated their choice to an expert. Figure 1 presents the market shares of the different projects for the other 85% of the sample. For each project the average costs are displayed between brackets (in million euros).

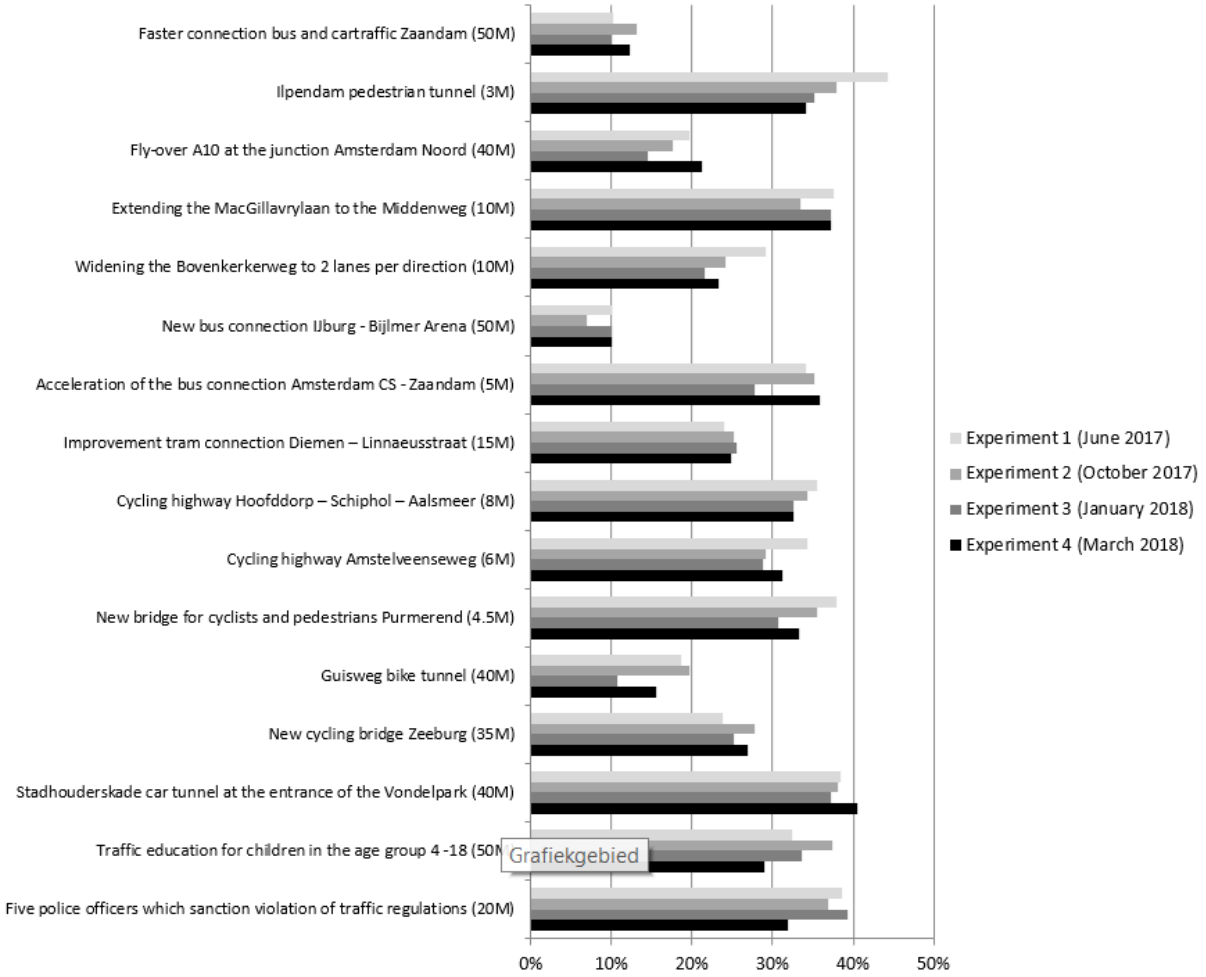

Figure 1: Percentage of respondents which selected the different transport projects

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 desired by a substantial part of the population of the TAA. Third, Figure 1 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 preferences for the 16 transport projects are fairly stable over time.

3.2 Quantitative results

Budget restrictions imply that not all public sector projects can be implemented and that policy makers will need to make trade-offs in deciding which projects (not) to implement. Dekker et al. (2019) have combined economic theory with behavioural choice modelling to identify the attractiveness of individual projects thereby enabling the identification of the optimal project portfolio in the PVE setting. To establish how citizens value the portfolios, the choices are quantitatively analysed using discrete-continuous choice models.[1] We estimate taste parameters in order to derive the relevance of societal impacts for which participants received explicit information in their choices. We estimate project specific parameters for each project which captures the utility individuals derive from a project irrespective of the level of the impacts included explicitly in the PVE. Both the taste parameters and the project specific parameters are presented in Figure 2 in the column 'Estimate'.

[1] We model portfolio utility as the sum of random project utilities and assume citizens choose the best portfolio given the governmental and private budget constraints using multiple discrete-continuous modelling approaches in the spirit of Bhat (2008, 2018). More information on modelling can be found in Dekker et al. (2019).

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 cartraffic 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 (35)	6.6641	**146.95**
B_Stadhouderskade car tunnel at the entrance of the Vondelpark	7.0658	**108.88**
B_Traffic 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 2: Estimation results behavioural choice model

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 obtained results can be used for welfare analysis 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 portfolios can be ranked in terms of expected social utility. Figure 3 shows the top 10 of portfolios within a budget constraint of 100 million euros.[2]

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

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 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 3: 10 portfolio's which result in the highest expected social utility 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 bride 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 optimal portfolio. Moreover, comparing the first-best and 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.

3.3 Qualitative results

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 motivations were manually coded. This produced 9,920 motivations, which were then divided across various categories. Figure 4 provides for each project an overview of the motivations put forward by citizens. For reasons of readability various small categories are excluded from the Figure 4.

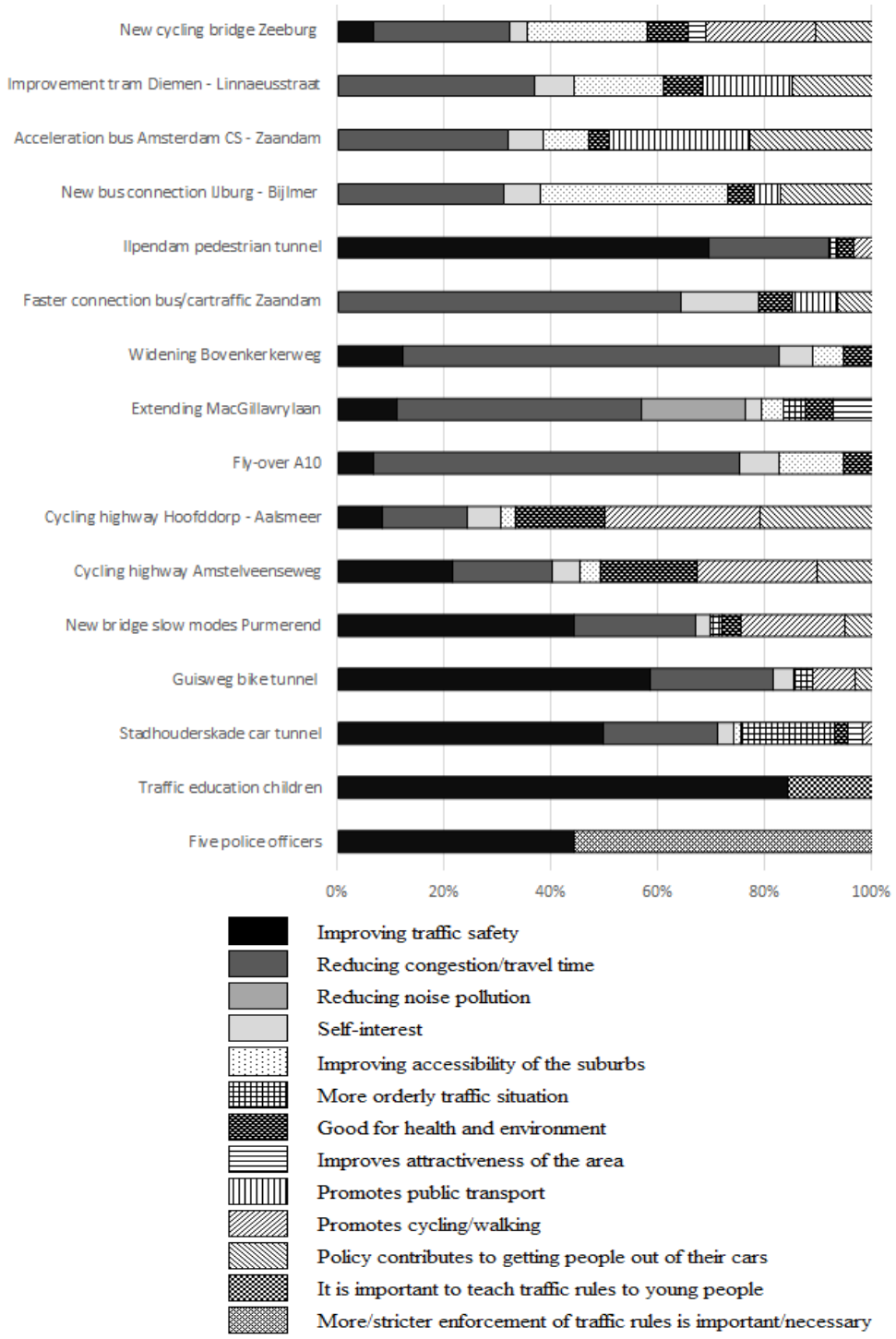

Figure 4: overview of qualitative motivations for each project

Figure 4 reveals that respondents clearly include other goals than the five impacts for which they received explicit information in their choices. 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 (18% positive impact on health and the environment; 31% promoting cycling; 22% trying to get people out of their car). Figure 4 also shows that for some projects the majority of the motivations that were mentioned by respondents align with the goals of transport that were explicitly addressed in the PVE. 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’. Respondents also mentioned various ethical considerations to underpin their selection of one of the projects in the PVE. The ethical consideration 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. Moreover, respondents mentioned unexpected motivations for underpinning their choices 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 281 respondents supported the addition of five police officers who focus exclusively on traffic safety, indicating that they had chosen it because stricter enforcement of the laws is desirable in and of itself. 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.

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