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DOI
10.1016/j.retrec.2025.101605

Publication date
2025

Document Version
Final published version

Published in
Research in Transportation Economics

Citation (APA)
de Vries, M. O., Hernández, J. I., & Mouter, N. (2025). The value of accessibility, health, safety, inclusion and sustainability: a public willingness to pay experiment. *Research in Transportation Economics*, *113*, Article 101605. https://doi.org/10.1016/j.retrec.2025.101605

Research in Transportation Economics 113 (2025) 101605

Contents lists available at ScienceDirect

Research in Transportation Economics

journal homepage: www.elsevier.com/locate/retrec

Research paper

The value of accessibility, health, safety, inclusion and sustainability: a public willingness to pay experiment

Martijn Olivier de Vries [a,b,*], José Ignacio Hernández [c], Niek Mouter [a,b]

[a] Delft University of Technology, Faculty of Technology Policy and Management, Department of Engineering Systems and Services, Jaffalaan 5, 2628 BX, Delft, the Netherlands

[b] Populytics, Strawinskylaan 339, 1077 XX, Amsterdam, the Netherlands

[c] Universidad San Sebastián, Faculty of Economics, Business and Government, Center for Economics and Sustainable Development, Lientur 1457, Concepción, Chile

ARTICLE INFO

JEL classification:
codes: R4
H50
Q50

Keywords:
Public willingness to pay
Cost-benefit analysis
Discrete choice experiment
Social choice valuation
Transport policy
Transport appraisal
Accessibility

ABSTRACT

Many countries use Cost-Benefit Analysis (CBA) as an ex-ante evaluation method to support transport decision-making. A critique on CBA is that it favours policies which produce easy to monetize impacts (e.g. travel time savings), whereas it disfavours policies which produce difficult to monetize impacts (e.g. minimum level of accessibility for people with a disability and environmental effects). Public willingness to pay (WTP) experiments have been introduced to value difficult to monetize policy impacts. This paper investigates how citizens of the Transport Authority Amsterdam value nine social impacts of transport policies through five Public WTP discrete choice experiments. In the experiments, respondents were asked to choose between transport policies, trading of social impacts against a uniform tax increase. We show that participants particularly value that people can reach key facilities within 15 min and assigned a relatively low value to preventing delays. This suggests that citizens prioritize accessibility over mobility. We also observe that participants assign a significant value to all the nine social impacts and identify Public WTP metrics for all the impacts. This suggests that the Public WTP approach has to potential to resolve the critique on CBA that not all impacts can be monetized.

1. Introduction

Cost-Benefit Analysis (CBA) is a widely used ex-ante evaluation method to support transport decision-making (e.g., Mackie et al., 2014; Welde & Odeck, 2011; Thomopoulos et al., 2009). In various countries, examples being the United Kingdom, Norway, the Netherlands and Sweden, CBA is mandatory when national funding is required for large transport projects (Mackie et al., 2014). Travel time savings are typically the most significant benefit in CBAs for transport policies, even though scholars widely regard other societal impacts to be relevant too. For instance, Mackie et al. (2001) note that in the UK, travel time savings represent about 80 % of the benefits in major road project CBAs, while Eliasson and Lundberg (2012) find that 90 % of the benefits in Sweden's Transport Investment Plan (2010–2021) stem from reduced travel times and transport costs. Many other societal outcomes tend to be excluded from the final indicators of the CBA, such as the net present value, examples being preventing social exclusion (Lucas 2012; Lowe et al., 2018), contributing to an inclusive society (Bondemark et al., 2020), attaining minimum levels of accessibility for people with a disability, attaining minimum levels of accessibility to important facilities (Martens, 2017; Ryan & Martens, 2023; Vecchio & Martens, 2021), environmental effects (Daniels & Hensher, 2000), the equitable distribution of (impacts of) transportation investments (Hickman & Dean, 2018; Mouter et al., 2017a; van Wee, 2011) and impacts of modal shift from car to bicycle including beneficial health outcomes from increased physical activity and space efficiency (de Hartog et al., 2010; Heinen et al., 2015; Adam et al., 2018; te Brömmelstroet et al., 2017; Van Wee & Börjesson, 2015).

A major critique on the CBA method in the scientific literature is that these broader societal impacts are often only qualitatively described in CBAs (e.g., Beukers, 2015; Handy, 2008; Mackie et al., 2014; Mouter et al., 2015, 2019; Nicolaisen et al., 2017). According to Carson (2012) this forces decision-makers to make arbitrary valuations about non-monetized societal impacts, which can result in skewed or erroneous conclusions. Based on interviews with 86 key actors in the Dutch CBA practice, Mouter et al. (2015) establishes that decision-makers

* Corresponding author. Delft University of Technology: Jaffalaan 5, 2628 BX, Delft, the Netherlands.
E-mail addresses: m.o.devries@tudelft.nl, martijn@populytics.nl (M.O. de Vries), jose.hernandez@uss.cl (J.I. Hernández), n.mouter@tudelft.nl, niek@populytics.nl (N. Mouter).

https://doi.org/10.1016/j.retrec.2025.101605
Received 11 February 2025; Received in revised form 28 May 2025; Accepted 5 July 2025
Available online 28 July 2025

recognize this relatively weak position of difficult-to-monetize effects in CBA. And by analyzing 67 CBAs conducted in the Netherlands between 2000 and 2011, Annema and Koopmans (2015) find that broader societal impacts are indeed often excluded from the overall conclusions of CBAs. Similar findings lead Hickman and Dean (2018) to conclude that CBA is only about comparing time savings relative to cost given that time savings of consumer users and business users make up over 80 % of the estimated benefits.

The fact that many societal outcomes are often not included in key CBA metrics seems to be predominantly a valuation issue, produced by certain ethical criteria embedded in standard CBA practices (Nash et al., 1975; Kelman, 1981; Sen, 2000; Hanson, 2007). When determining the social welfare gains and losses of transport projects, certain value judgements must be made about whose preferences count, what kind of preferences count and under what conditions (Nash et al., 1975). Conventional CBA assumes that impacts of government projects should be valued based on the amount of money that individuals are willing to pay from their private income for realizing positive or preventing negative impacts (Sugden, 2007). This private willingness to pay (WTP) approach to value social welfare gains and losses in CBA has extensively been criticized for making value judgements that limit the reach of ethical analysis underlying public decisions (Ackerman & Heinzerling, 2004; Mouter & Chorus, 2016; Nyborg, 2014; Sen, 2000). Below, we discuss two key points of criticism which might prevent various societal outcomes from being monetized in CBAs. But first, we provide a brief introduction to the Private WTP approach.

The Private WTP approach converts impacts into monetary terms using the notion of the amount of private income that individuals are willing to pay. To this end, it relies on market prices and revealed and stated preference methods like hedonic pricing studies and stated choice surveys. For instance, the standard empirical approach that is used to identify the value of travel time savings from government projects relies on (hypothetical) route choice experiments. In these experiments, respondents are asked to make a series of private choices between routes which differ in terms of travel time and travel costs (Abrantes & Wardman, 2011; Batley et al., 2019; Börjesson & Eliasson, 2014; Ehreke et al., 2015; Jara-Díaz, 2007; Kouwenhoven et al., 2014). Similarly, impacts of government projects on landscape and noise pollution are evaluated through investigating the private decisions people make when buying a house (e.g. Allen et al., 2015; Seo et al., 2014).

The literature offers two reasons why this Private WTP approach might have difficulty with obtaining monetary values for various social impacts of transport policy. First, several scholars argue that the assumption that social welfare is determined by Private WTP excludes all kinds of preferences that are not (adequately) measured through (hypothetical) markets, because market behavior predominantly reflects what an individual personally prefers (Nash et al., 1975; Nyborg, 2000; Sen, 2000). These scholars argue that the sum of individuals' personal preferences does not necessarily coincide with how they believe the government should allocate scarce public resources. For instance, citizens may not be willing to contribute individually to a public good because, in their view, the impact of their individual contribution is negligible. People may, however, be willing to contribute when the whole community contributes, since the impact of coordinated efforts can be substantial (Ivehammer, 2009; Lusk & Norwood, 2011; Pfaff, 2019; Sen, 1995). Nyborg (2000) explains that the preferences of an individual with *sole responsibility* might differ from those of an individual with *shared responsibility*. To illustrate this, consider an individual who is asked whether she wants to contribute 10 euro to a project which aims to improve accessibility for people with a disability costing 100 million euros in total. The individual might reject this contribution because the impact of her individual contribution is negligible. However, the same individual might agree with a one-time uniform tax increase of 10 euro for all the 10 million households in the country to realize this project since the impact of this tax increase is substantial in the sense that the project can then be realized. Hence, people might be willing to pay collectively for social impacts of a government policy, but due to collective action problems this may not be observed through market prices, hedonic pricing studies or stated preference studies adopting a Private WTP approach.

A second reason why the Private WTP approach might have difficulty with obtaining monetary values for various social impacts is that people might not be able to imagine trading off their own income against such impacts in (hypothetical) market situations (Sen, 2000). A similar point is made by Nash et al. (1975), who stress the need to determine under which conditions people's preferences should count in CBA, because people may be qualified to express their Private WTP for simple policy impacts, but not for complex ones. Indeed, it might be very hard for citizens to express their Private WTP for alternatives such as the equitable distribution of transportation investments or attaining minimum levels of accessibility for people with a disability, as citizens will generally have no experience with trading of these impacts against their own income in day-to-day choices. Such issues probably do not hold for impacts such as travel time savings and traffic safety as many people will have quite some experience with trading of time and private income and safety and private income in day-to-day choices. For this reason, while the Private WTP approach might be suitable for valuing social impacts which individuals actually trade-off against their own income in their daily lives (e.g. time and safety), other methods that go beyond (hypothetical) market valuation by providing tangible information about specific social states (Sen, 2000) might be needed for valuing impacts that individuals hardly ever trade-off against their own income in their daily lives (e.g. spatial equality, providing minimum levels of accessibility to specific segments of the population).

To ameliorate the issues stated above, impacts of government projects have been evaluated through Public willingness to pay (WTP) experiments (Mouter et al., 2021). In Public WTP experiments the impacts of government projects are presented in terms of how they affect the entire community and financed by a uniform tax increase or alternative but comparable payment vehicle (e.g. Andersson & Lindberg, 2009; Bishop et al., 2017; Daniels & Hensher, 2000; Hultkrantz et al., 2006; Ivehammer, 2009, 2008, 2014; Mouter & Chorus, 2016; Nyborg, 2000). We argue that such a framing more closely resembles reality and people's experience with valuing many social impacts of government decisions. For example, people can probably better imagine their government considering a tax increase to finance a transport policy which aims to attain minimum levels of accessibility for people with a disability (Public WTP approach), compared to a situation in which such a government project is realized from individual contributions (Private WTP approach). An additional benefit of the Public WTP approach is that tangible information about specific social states can be provided to assist people with making informed decisions about complex trade-offs. For instance, respondents can be informed about how much everyone would have to pay for the proposed policy option to resolve the coordination problem associated with private WTP studies. While doing so, Public WTP experiments still make the connection between policy impacts and private income, the only difference is that the decision problem is formulated in the context of the actual public decision in which an individual must decide whether the overall positive and negative impacts of a government project warrant a (often uniform) tax increase (Mouter et al., 2021). This means individuals express their preferences toward a collective choice of the government that potentially affects their private income and that of others. A benefit of this approach is that it allows individuals to express their preferences towards so-called 'merit goods' (Musgrave, 1959). That is, individuals can favour the provision of certain goods by the government through a tax increase because they think that it is beneficial for society if a minimum level of these goods are provided. Jacobsson, Johannesson, and Borgquist (2007) mentions health care and education as examples of merits goods for which the government provides minimum access levels, also to people which might prefer a monetary transfer over having access to health care and education.

Table 1
Overview of the attributes and attribute levels.

Attribute	Detailed description	Level 0	Level 1	Level 2	Level 3	Level 4	Level 5
How many people can access their work within 45 min by public transport, bike, car or by foot? (Accessibility)	Some residents of the Amsterdam transport region have to travel a long way to work. By investing in public transport, roads, cycle paths and walking routes, the Transport Region can ensure that more people can travel to work within 45 min.	5000 *less* people can access their work within 45 min	No effect	5000 *additional* people can access their work within 45 min	10,000 *additional* people can access their work within 45 min	15,000 *additional* people can access their work within 45 min	20,000 *additional* people can access their work within 45 min
How many people can access important facilities within 15 min by public transport, bike, car or by foot? (Accessibility)	Important facilities include a supermarket, a primary school and a general practitioner. The Transport Region can make investments to ensure that more people can reach these facilities within 15 min.	1000 *less* people can access important facilities within 15 min	No effect	1000 *additional* people can access important facilities within 15 min	2000 *additional* people can access important facilities within 15 min	3000 *additional* people can access important facilities within 15 min	4000 *additional* people can access important facilities within 15 min
How many times per year are people at least 15 min later than expected at their destination? (Accessibility)	There are various causes for travel delays. For example, a traffic jam, a cancelled bus or a delayed tram. The Transport Region can make investments that will reduce the number of delays.	people are at least 15 min later than expected 5 times *less* per year	No effect	people are at least 15 min later than expected an *additional* 5 times per year	people are at least 15 min later than expected an *additional* 10 times per year	people are at least 15 min later than expected an *additional* 15 times per year	people are at least 15 min later than expected an *additional* 20 times per year
How many traffic deaths are there per year in the region? *At the moment 45 per year* (Safety)	The Transport Region can reduce these numbers through safety measures, such as road design or behavioural campaigns.	5 *additional* traffic deaths	No effect	*Reduction* of 5 traffic deaths	*Reduction* of 10 traffic deaths	*Reduction* of 15 traffic deaths	*Reduction* of 20 traffic deaths
How many severe injuries are there per year in the region? *At the moment 500 per year* (Safety)	The Transport Region can reduce these numbers through safety measures, such as road design or behavioural campaigns.	50 *additional* severe injuries	No effect	*Reduction* of 50 severe injuries	*Reduction* of 100 severe injuries	*Reduction* of 150 severe injuries	*Reduction* of 200 severe injuries
How many people dare to cycle independently in traffic? *At the moment, approximately 30,000 people do not dare to cycle in the region* (Safety)	Some people no longer dare to cycle independently, for example due to traffic on the road. By making the street safer or redesigning more streets for cyclists, more people will dare to cycle independently.	Number of people that dares to cycle independently *decreases* with 1000	No effect	Number of people that dares to cycle independently *increases* with 1000	Number of people that dares to cycle independently *increases* with 2000	Number of people that dares to cycle independently *increases* with 3000	Number of people that dares to cycle independently *increases* with 4000
How many trips are made by public transport, by bike or by foot instead of by car per day? *There are approximately 1,500,000 trips in the region per day* (Sustainability)	By investing in public transport, cycle paths and walking routes, the Transport Region can encourage people to travel less by car and more by public transport, bicycle or on foot. As a result, they emit fewer harmful substances and travel becomes more sustainable.	25,000 additional trips per day are made by car instead of by public transport, by bike or by foot	No effect	25,000 additional trips per day are made by public transport, by bike or by foot and not by car	50,000 additional trips per day are made by public transport, by bike or by foot and not by car	75,000 additional trips per day are made by public transport, by bike or by foot and not by car	100,000 additional trips per day are made by public transport, by bike or by foot and not by car
How many people experience nuisance in their living area? *At the moment, 160,000 residents of the region experience nuisance* (Health)	People can experience traffic nuisance in various ways. For example, through the noise of cars and buses driving through the street. Or through the exhaust fumes of cars, trucks and mopeds that pollute the air. By taking traffic measures, the Amsterdam Transport	40,000 people experience *more* nuisance	No effect	40,000 people experience *less* nuisance	80,000 people experience *less* nuisance	120,000 people experience *less* nuisance	160,000 people experience *less* nuisance

(*continued on next page*)

Table 1 (*continued*)

Attribute	Detailed description	Level 0	Level 1	Level 2	Level 3	Level 4	Level 5
	Region can reduce this nuisance.						
How many people can access, understand and use public transport? *Currently, 78,000 people cannot access, understand or use public transport* (Inclusion)	Not all bus, tram and metro stops are accessible. For example, because there are no guidelines for the blind. Or because the bus stop is not raised. As a result, some people cannot enter the bus, tram or metro independently. By making more bus and tram stops accessible, people with disabilities can travel by public transport more easily. Understanding public transport is about the accessibility of public transport for people with low literacy or visual impairment. Comprehensibility is very important for being able to make a journey by public transport.	Number of people that can access, understand and use public transport *decreases* with 15,000	No effect	Number of people that can access, understand and use public transport *increases* with 15,000	Number of people that can access, understand and use public transport *increases* with 30,000	Number of people that can access, understand and use public transport *increases* with 45,000	Number of people that can access, understand and use public transport *increases* with 60,000
Uniform tax for all households (Costs)	Some approaches are more expensive than others. To cover the costs of approaches, a one-off additional tax may be charged to households in the transport region.	Tax *reduction* of €25	€ 0,-	Tax *increase* of €25	Tax *increase* of €50	Tax *increase* of €100	Tax *increase* of €150

In transport research there are a few studies which can be identified as employing a Public WTP approach, in that they ask respondents to simultaneously evaluate positive and negative impacts of transport projects in a public context. Daniels and Hensher (2000) asked respondents whether they thought that the government should build the M5 East, a 13-km extension of an existing tolled motorway while being informed about the impact of the extension on travel time savings, noise pollution, bushland lost, open space lost and a community contribution from Sydney households, amongst other things. The study found that participants did not assign significant value to negative environmental impacts, but they also did not find a significant value for travel time savings. Ivehammar (2008) conducted an experiment in which Swedish citizens were asked whether they supported a new road project which was financed by a local tax increase resulting in travel time savings and environmental encroachment. She finds that respondents assign an important value to preventing environmental encroachment, as 48 % of respondents rejected the road project even though the travel time savings were substantial (8 min per single trip). Ivehammer, 2009 concludes that respondents were indifferent between saving 31 min of travel time per month and preventing environmental encroachment. Mouter et al. (2019) conducted Public WTP experiments in which respondents were asked to choose between alternatives for a new road while receiving information on the impact of the road on travel time, noise pollution, recreation, biodiversity and a one-time tax increase. They find that individuals assign substantially more value to environmental impacts than travel time as compared to conventional valuation studies. Moreover, they find that participants assigned monetary values to impacts that are generally not (or only qualitatively) considered in conventional CBAs of transport projects such as recreation and biodiversity. This finding raises the question if the Public WTP approach can also be deployed to obtain monetary values for other impacts of transport projects that are difficult to monetize using the Private WTP approach.

Our study seeks to answer this question through conducting five Public WTP studies for the Transport Authority Amsterdam (TAA). Respondents were asked to choose between alternative transport policies trading of several social impacts against a uniform tax increase. In total, nine social impacts were selected by policymakers, who saw these as the most relevant impacts in the appraisal of TAA's transport policies. Hence, our research question is: can we obtain willingness to pay metrics for all nine social impacts of transport policies of the TAA through conducting Public WTP studies? Section 2 outlines the methodology of our Public WTP experiment, of which the results are presented in section 3. Finally, section 4 discusses the results and section 5 provides a conclusion.

2. Methodology

For this study we conducted five Discrete Choice Experiments (DCEs) in a Public WTP context. This means that respondents traded off a range of social impacts of transport policies, including a tax increase against each other in a public context. In the DCEs, respondents complete a series of choice tasks, each consisting of two transport policy alternatives. Each alternative is defined by a set of social impacts, (referred to as attributes) with varying levels across the different choice tasks, so that the choice tasks differ in their specific attributes. For each choice task, respondents select their preferred option. Subsequently, discrete choice models are employed to estimate individuals' preferences regarding the attributes. The Public WTP experiments adopt a non-paternalistic approach as individuals are not urged to take a certain perspective when making choices. That is, they are free to express preferences while identifying themselves with each member of society (which Harsanyani, 1955 coins as ethical preferences) or take a purely self-interested perspective.

2.1. Selecting attributes and determining the attribute levels

To define the attributes for our study we analysed which impacts were mentioned in the policy framework of the TAA (Transport

Fig. 1. Example of a choice task.

Table 2
attributes included in the five DCEs.

	DCE 1	DCE 2	DCE 3	DCE 4	DCE 5
How many people can access their work within 45 min by public transport, bike, car or by foot?			X	X	
How many people can access important facilities within 15 min by public transport, bike, car or by foot?		X		X	
How many times per year are people at least 15 min later than expected at their destination?	X			X	X
How many traffic deaths are there per year in the region?	X				
How many severe injuries are there per year in the region?		X			
How many people dare to cycle independently in traffic?			X		X
How many trips are made by public transport, by bike or by foot instead of by car per year?		X		X	
How many people experience nuisance in their living area?	X				X
How many people can access, understand and use public transport?			X	X	
Uniform tax for all households	X	X	X	X	X

Authority Amsterdam, 2023). This framework states that the goal of the TAA is to improve the 'broad prosperity' in the TAA through improving the accessibility, safety, sustainability, health and inclusiveness of the transport system. Based on our analysis of the framework, we identified 28 social impacts the TAA aims to influence through their policies. In a meeting with eight experts from the TAA we decided which of these impacts would be relevant for our study. An impact was considered relevant if it was influenced by a substantial number of concrete transport projects from the TAA. This criterion was adopted because CBA is generally used for the evaluation of specific transport projects. In the meeting 9 impacts were selected. The other 19 impacts were not considered relevant enough or too difficult to include because the causality between the implementation of specific projects and the pursued social impact was unclear. For instance, impacts such as 'decrease in number of people with heart disease', 'decrease in the number of people with asthma and COPD' and 'increase in percentage of residents in the TAA who experience their environment as healthy' were not included in our study, because the experts thought there was not enough proof that specific transport projects could substantially influence these impacts. Such impacts are seen as broader goals that the TAA pursues in their joined planning processes with municipalities, the province of North Holland and the national government.

The attribute levels were defined in consultation with two experts from the TAA. For each impact, it was estimated what the size of the impact could be when 250 million euro would be invested to foster the impact (around 150 euro per household). We used this estimation as the highest attribute level (5) in our design (Table 1). For each of the attributes we also included a negative level because experts from the TAA emphasized that policy choices could potentially lead to an increase in one social impact at the expense of another impact. By also including a level with a negative effect, such a trade-off can be simulated in the DCE choice tasks. Finally, a detailed description and estimation of the baseline situation was provided by experts from the TAA (for 6 out of 9 attributes). Participants read this information prior to conducting the DCE and could also access it by clicking the pink information buttons in the choice tasks (Fig. 1).

2.2. *Experimental design*

We decided to conduct five discrete choice experiments, each containing four to six attributes as Caussade et al. (2005) show conducting DCEs with more attributes has a clear detrimental effect on people's ability to choose, contributing to a higher error variance. Table 2 shows which attribute were included in the five discrete choice experiments. Each DCE contained the cost attribute which allows us to jointly analyse the choices in discrete choice models. The other attributes were included on some DCE versions based on the following considerations. In DCEs 1, 2 and 3 we included one accessibility attribute, one traffic safety attribute, and one of the other three attributes. In DCE 4, we included all three accessibility attributes, the sustainability attribute and the inclusiveness attribute. The rationale for including these attributes in DCE 4 is that a substantial number of respondents might be inclined to only focus on traffic safety in a Public WTP setting which makes it hard to identify people's preferences for other attributes (Mouter et al., 2017b). Finally, DCE 5 was constructed after the pilot study and included the three attributes that were insignificant in the pilot study and the uniform tax attribute. This ensured that there is a higher probability that we could identify people's preferences for these attributes.

To construct the binary choice situations for each DCE, the attributes and levels presented in Table 1 were used. For each DCE, 30 binary choice situations were made (totalising 150 choice situations for the whole experiment). These choice situations were constructed using a D-efficient experimental design (Rose & Bliemer, 2009). In this D-efficient design, the attribute levels of each choice situation are selected aiming to minimise the determinant of the variance-covariance matrix of a Multinomial Logit model (known as the D-error) with a linear utility function of the 150 choice situations, instead of creating independent D-efficient designs for each DCE. By doing so, our design aims to maximise the statistical efficiency of the whole experiment.

The D-efficient design of our experiment was conducted in two stages. In the first pilot stage, we constructed 30 choice situations for

Table 3
Sociodemographic of the sample and adult population.

	Percentage of DCE participants	Percentage of the TAA population (CBS, 2023)	Chi-squared test (p-value)
Total	2100		
Female	47,8 %	47.8 %	0.07 (0.80)
Male	51,5 %	52.2 %	
18–25 years	9,4 %	17.2 %	
25–34 years	14,2 %	23.3 %	296.18 (<0.01)
35–44 years	20,0 %	18.8 %	
45–54 years	13,7 %	15.8 %	
55–64 years	16,2 %	14.8 %	
65 years or older	21,6 %	10.2 %	
Low education level	16,8 %	22.1 %	61.27 (<0.01)
Medium education level	37,0 %	30.2 %	
High education level	45,7 %	47.7 %	

DCE 1 to 4, using small prior values with fixed signs for each attribute. In addition, we imposed a priori conditions to the experimental design to rule out strictly dominant and dominated alternatives in all choice situations, because such alternatives provide no relevant information about respondents' trade-offs for attributes, negatively affecting the statistical efficiency of the estimates of the final model. In the second stage, we used the responses to the pilot survey to obtain estimates of a MNL model, which were used as priors for the final D-efficient design, keeping the same conditions as before to avoid strictly dominant and dominated alternatives. Fig. 1 provides a screenshot of one of the choice situations. All experimental designs were constructed using ChoiceDesign, a Python package for constructing experimental designs for DCEs.[1]

2.3. Data collection

The respondents to the DCE were recruited from an internet panel of Dynata between May 22nd and June 13th, 2024, with the aim of being representative of the population of the TAA regarding gender, age and education. After data cleaning, a total of 2100 respondents completed the DCE experiments. Table 3 reports the sociodemographic characteristics of the sample and shows that all the relevant segments of the population are included in the study.

2.4. Statistical analysis

The data analysis of this DCE was done using discrete choice models based on the Random Utility Maximisation (RUM) framework. A key feature of this framework is that it allows for a straightforward interpretation of its estimates as the marginal utility of increases of specific attributes, which in turns permits the computation of marginal rates of substitution and the marginal willingness to pay for the increase of each attribute (Train, 2009). This latter feature is particularly important for the goal of this study, as it concerns investigating the extent that willingness to pay metrics can be obtained for the nine social impacts using a Public Willingness to Pay approach.

The mathematical formulation of the model used in this study is based on Train (2009). The n be a decision-maker who faces J mutually exclusive alternatives. The utility of alternative $j \in \{1, \ldots, J\}$ is given by equation (1):

$$U_{nj} = V_{nj} + \varepsilon_{nj} = \sum_k \beta_k \cdot X_{njk} + \varepsilon_{nj} \tag{1}$$

where β_k is the parameter associated with the k-th attribute X_{njk}, and ε_{nj} is the stochastic error term. Since the alternatives of this DCE are unlabelled, no Alternative Specific Constants (ASCs) are used.

Under the RUM framework, alternative i is chosen if $U_{ni} > U_{nj}$. However, the analyst cannot directly observe the utility of any alternative, as they depend of a stochastic term. McFadden (1974) shows that, by assuming a i.i.d Gumbel distribution for ε_{nj}, the choice probabilities of each alternative take the form of the Multinomial Logit (MNL) model shown in equation (2):

$$P_{ni,MNL} = Prob\left(U_{ni} \geq U_{nj}, \forall j \neq i\right) = \frac{\exp(V_{ni})}{\sum_j \exp(V_{nj})} \tag{2}$$

Using the Maximum Likelihood Estimation method, it is possible to obtain an estimation of the β_k.The estimated parameters of this model can be interpreted as the marginal utility of increasing the associated attribute k in one unit. Hence, if $\beta_k > 0$, an increase of attribute k would lead to an increase of the decision-makers' utility. Conversely, if $\beta_k < 0$, the increase of attribute k implies a decrease of the decision-makers' utility. Furthermore, the ratio of β_k and β_i can be interpreted as the marginal rate of substitution between attributes k and i. Taking this notion, the marginal willingness to pay for attribute k can be computed by the negative ratio between β_k and the marginal utility of the cost attribute, as in equation (3):

$$MWTP_k = -\frac{\beta_k}{\beta_{Cost}} \tag{3}$$

In addition to the MNL model, we estimated a Latent Class (LC) choice model to account for and characterize the heterogeneity of respondents across different groups. A LC model can both account for heterogeneity in terms of tastes (i.e., each class has their own set of β terms) and permits to characterize each class in terms of a set of respondent-specific characteristics. The modelling approach through which we arrived at an optimal 3-class LC model is reported in supplementary material A. There, we also present the model results, which shed some light on the differences in taste parameters and sociodemographic characteristics of the three classes. The model results are only reported in the supplementary material A because they are not very fine-grained and were of little relevance for policy makers of the TAA.

Finally, and as a robustness check, we also estimated a Mixed Logit (MXL) model (McFadden & Train, 2000). The MXL model extends the MNL model by accounting for unobserved heterogeneity across respondents through so-called random parameters. This incorporation lifts the assumption that all respondents have the same tastes for the attributes of the DCE (i.e., they have the same β parameters). Instead of having a fixed value of each $\beta k \beta k$, in the MXL model, these parameters follow a distribution across all decision-makers. Mathematically, the utility of each decision-maker nn is given by equation (4):

$$\begin{aligned} \mathrm{Unj} = \mathrm{Vnj} + \varepsilon\mathrm{nj} = \sum \mathrm{k}\beta\mathrm{nk}\cdot\mathrm{Xnjk} + \varepsilon\mathrm{nj}\mathrm{Unj} = \mathrm{Vnj} + \varepsilon\mathrm{nj} \\ = \sum \mathrm{k}\beta\mathrm{nk}\cdot\mathrm{Xnjk} + \varepsilon\mathrm{nj} \end{aligned} \tag{4}$$

where βnkβnk is the k-th random parameter for decision-maker nn. The random parameters βnkβnk follow a distribution with density f (β|θ)$f\beta|\theta$. The analyst assumes a specific distribution for each random parameter and aims to estimate the parameters that describe such distribution (i.e., the θθ). For instance, if the analyst assumes that βk ∼ N (β−,sβ)$\beta k \sim N (\beta\text{-}, s\beta)$, the MXL model provides an estimate of β−β-and sβ$s\beta$.

Following Train (2009), the choice probabilities of the MXL model take the form described in equation (5):

[1] More details about ChoiceDesign can be found in this link: https://github.com/ighdez/choicedesign.

Table 4
Results from the estimation of the MNL model.

Attribute	Estimate	Std. Err.	P-value
1000 More people can reach their work within 45 min	0.019	0.003	0.000
1000 More people can reach important facilities within 15 min	0.095	0.015	0.000
10 Additional delays of at least 15 min for all citizens of the region	−0.039	0.021	0.064
10 Additional traffic fatalities per year	−0.416	0.039	0.000
10 Additional severe injuries per year	−0.027	0.004	0.000
1000 More people dare to cycle independently	0.091	0.012	0.000
10,000 Extra trips by public transport, bike or foot instead of by car	0.028	0.006	0.000
10,000 More people experience nuisance from traffic	−0.011	0.003	0.001
10,000 More people can access, understand and use public transport	0.100	0.011	0.000
Tax increase of 10 euro	−0.054	0.002	0.000
Model outputs:			
Number of observations			10,490
Log-likelihood			−6763.86
AIC			13,547.72
BIC			13,620.30
Rho-squared			0.07

$$\begin{aligned} \mathrm{Pni,MXL} &= \int \exp(\mathrm{Vni}) \sum \mathrm{jexp}(\mathrm{Vnj}) \mathrm{f}(\beta||\theta) \partial\theta \mathrm{Pni,MXL} \\ &= \int \exp - \mathrm{Vni} \sum \mathrm{jexp} - \mathrm{Vnjf}\beta\theta \Big) \partial\theta \end{aligned} \tag{5}$$

Because of the integral of equation (5), the choice probabilities do not have a closed form. Hence, the analyst must rely on simulation techniques to approximate the log-likelihood function. A detailed description of these procedures is given by Train (2009, Ch. 6). An additional requirement of the MXL model is that the analyst must specify a specific distribution to the random parameters. In this paper, we assume normally distributed random parameters associated to all attributes, except for the additional tax per household. The reason behind that is, as discussed by Revelt and Train (2000) and Sillano and de Dios Ortúzar (2005), MXL models with only random parameters tend to be unstable and leaving one fixed parameter solves this issue. In addition, this accommodation facilitates the computation of WTP measures – which is the aim of this study – as the distribution of them follow the distribution of the random parameters associated with the attributes, circumventing the need of deriving the distribution of the WTP measure itself. Lastly, assuming known distributions for the cost parameter (in our case, the parameter associated with a tax increase), such as normal or log-normal, is problematic, as part of these distributions rely on values close to zero (or negative, in the case of a normal distribution), exacerbating the resulting WTP values computed from equation (3).

3. Results

3.1. MNL results

Table 4 presents the estimation results of the MNL model. The estimates of all parameters are significantly different from zero at the 90 % confidence level and the signs are in the a priori expected directions. Hence, all social impacts significantly influence respondents' choices when making trade-offs. To illustrate the interpretation of the results presented in Table 4, consider that the TAA needs to decide between two transport policies. Policy A results in a reduction of 10 delays per year of 15 min for all citizens in the region (+0.039) and Policy B results in 1000 additional people who can reach important facilities within 15 min (+0.095). In this case Policy B is favoured because the average respondent derives more utility from 1000 people more being able to reach important facilities within 15 min than a reduction of 10 delays of at least 15 min for all citizens. Moreover, from Table 4 it can be derived that the average respondent is willing to accept 10 delays of at least 15 min per year for all citizens in the region (−0.039) to prevent one additional traffic fatality (−0.042).

Table 5
Overview of total Public WTP estimations computed from the MNL model.

	Public WTP per household	95 % confidence interval Low	95 % confidence interval High	Total Public WTP TAA (838,000 households)
1 Citizen can reach work within 45 min by public transport, bike, car or by foot	0.0035€	€ 0.0023	€ 0.0047	2923€
1 Extra citizen can reach important facilities within 15 min by public transport, bike, car or by foot	0.0201€	€ 0.0121	€ 0.0227	16,848€
Reduction of 1 delay of at least 15 min for all citizens of the region	0.683€	-€ 0.0371	€ 1.4587	572,037€
Reduction 1 traffic fatality per year	7.75€	€ 6.2490	€ 9.0670	6,492,084€
Reduction 1 severe injury per year	0.548€	€ 0.3334	€ 0.6454	459,575€
1 Extra citizen dares to cycle independently	0.0169€	€ 0.0122	€ 0.0212	14,168€
1 Extra trip per day by public transport, bike or foot instead of by car	0.0006€	€ 0.0003	€ 0.0007	463€
1 Citizen experiences less nuisance from traffic	0.0002€	€ 0.0000	€ 0.0004	173€
1 Extra citizen can access, understand and use public transport	0.0019€	€ 0.0014	€ 0.0022	1576€

Besides the parameter estimates, the marginal rates of substitution (Public WTP) between the nine social impacts and costs can also be calculated. Given our linear-additive RUM-MNL specification, the marginal rates of substitution are given by the ratios of the parameters. Table 5 presents these WTP metrics, including confidence intervals. When multiplying these WTP metrics with the number of households in the TAA (around 838,000), the total Public WTP can be derived for the TAA. We describe these results below Table 5.

For the three social impact attributes related to traffic safety, the total Public WTP estimates are as follows. First, the total Public WTP for saving a statistical human life is €6.4 million. This is almost equal to the metric that is used by the Dutch national government (€6.5 million). Second, the total public WTP to prevent a serious injury is €406,202 which is a bit lower than the standard metric used by the Dutch national government €700,000 (Wijnen, 2020). Third, total Public WTP for the attribute '1 extra person dares to cycle independently in traffic' is €14, 110. In the Netherlands, there are no clearly established subjective traffic safety metrics to compare this to.

Next, we describe the total Public WTP for the three social impact attributes related to accessibility. First, citizens are willing to accept a tax increase of €0.0035 to ensure that 'one citizen can reach work within 45 min' This accumulates to a total Public WTP of €2905. Converting this to 240 working days per year, this results in a total Public WTP of

Table 6
Results from the estimation of the MXL model.

Attribute	Estimate	Std. Err.	P-value
Mean			
1000 More people can reach their work within 45 min	0.024	0.005	0.000
1000 More people can reach important facilities within 15 min	0.109	0.021	0.000
10 Additional delays of at least 15 min for all citizens of the region	−0.063	0.027	0.018
10 Additional traffic fatalities per year	−0.521	0.061	0.000
10 Additional severe injuries per year	−0.031	0.005	0.000
1000 More people dare to cycle independently	0.104	0.015	0.000
10,000 Extra trips by public transport, bike or foot instead of by car	0.035	0.007	0.000
10,000 More people experience nuisance from traffic	−0.012	0.005	0.017
10,000 More people can access, understand and use public transport	0.133	0.017	0.000
Tax increase of 10 euro	−0.063	0.002	0.000
Standard deviation			
1000 more people can reach their work within 45 min	0.074	0.008	0.000
1000 More people can reach important facilities within 15 min	−0.240	0.039	0.000
10 additional delays of at least 15 min for all citizens of the region	0.348	0.066	0.000
10 additional traffic fatalities per year	0.569	0.096	0.000
10 additional severe injuries per year	0.041	0.012	0.001
1000 more people dare to cycle independently	−0.093	0.051	0.070
10,000 extra trips by PT, bike or foot instead of by car	−0.070	0.018	0.000
10,000 more people experience nuisance from traffic	−0.088	0.008	0.000
10,000 more people can access, understand and use public transport	−0.200	0.029	0.000
Model outputs:			
Number of observations			10,490
Log-likelihood			−6664.84
AIC			13,367.69
BIC			13,505.59
Rho-squared			0.08

around €12 per working day. The total WTP for ensuring that ‘one citizen can access important facilities within 15 min’ is higher than this. Citizens are willing to accept a tax increase of around 2 eurocents to ensure this, which accumulates to a total Public WTP of €17,430. Finally, the total Public WTP to ‘ensure that all travellers in the TAA experience one delay less per year of at least 15 min’ does not significantly differ from zero. Hence, we cannot claim with enough confidence based on the results of the MNL model that citizens are willing to pay for the prevention of delays. However, when we use the mean total Public WTP of €566,309 then the Public WTP for preventing a delay of at least 15 min for all travellers is around €0.33 as around 1,500,000 trips made per day in the TAA. This is lower than the value of travel time metrics that are used in the Netherlands which are €10 per hour.

For the final three social impact attributes, related to inclusivity, sustainability and health, the total Public WTP estimates are as follows. The Public WTP to ensure that ‘1 additional resident can better access, understand or use public transport and thereby fully participate’ is €1560. Assuming 240 travel days, this is around €6.5 per travel day. The Public WTP to ensure that ‘1 resident decides to make a trip with public transport, bicycle or walking instead of with a car’ is €459, which is around €1.5 euro per day. The Public WTP to ensure that ‘1 resident experiences less nuisance from traffic in the environment’ is not significant at the 95 % confidence level.

Table 7
Comparison of total Public WTP computed from MNL and MXL models.

	Public WTP per household		Confidence interval MXL model	
	MNL	MXL	95 % confidence interval Low	95 % confidence interval High
1 Extra citizen can reach work within 45 min by public transport, bike, car or by foot	€ 0.0035	€ 0.0038	€ 0.0022	€ 0.0054
1 Extra citizen can reach important facilities within 15 min by public transport, bike, car or by foot	€ 0.0201	€ 0.0172	€ 0.0107	€ 0.0237
Reduction of 1 delay of at least 15 min for all citizens of the region	€ 0.683	€ 0.993	€ 0.1777	€ 1.8081
Reduction of 1 traffic fatality per year	€ 7.75	€ 8.24	€ 6.38	€ 10.12
Reduction of 1 severe injury per year	€ 0.548	€ 0.498	€ 0.327	€ 0.669
1 Extra citizen dares to cycle independently	€ 0.0169	€ 0.0164	€ 0.0119	€ 0.0209
1 Extra trip per day by public transport, bike or foot instead of by car	€ 0.0006	€ 0.0006	€ 0.0004	€ 0.0008
1 Citizen experiences less nuisance from traffic	€ 0.0002	€ 0.0002	€ 0.0000	€ 0.0004
1 Extra citizen can access, understand and use public transport	€ 0.0019	€ 0.0021	€ 0.0015	€ 0.0027

3.2. MXL model results

Table 6 presents the results of the MXL model. All mean parameters are statistically significant at the 95 % confidence level and have the expected sign. In addition, all standard deviation parameters are statistically significant, which confirms the existence of heterogeneity of preferences across respondents. Given the assumption of normally distributed random parameters, the interpretation of results must be done in terms of both the mean and standard deviation parameters. On the one hand, a positive sign of the mean implies that a majority of respondents prefer an increase of the associated attribute, while a negative sign of this parameter implies that more respondents prefer reductions of such attribute. On the other hand, the fact that all standard deviation parameters are statistically significant implies that a proportion of respondents prefer the opposite of what the mean parameters suggest. To illustrate this, consider the mean estimate associated with 1000 more people that can reach their work within 45 min (+0.024), which means that most respondents are in favour of increases of this attribute. However, as the standard deviation parameter is statistically significant, there is a proportion of respondents who derive a negative utility from an increase of this attribute.

Table 7 compares the Public WTP metrics derived from the MXL model with the MNL model. We observe that the Public WTP metrics derived from both models are similar and therefore conclude that the values obtained from the MNL model are robust. Moreover, we see that the Public WTP estimates are significant for all attributes, including those that were not significant in the MNL model. These were the attributes ‘ensure that all travellers in the TAA experience one delay less per year of at least 15 min’ ($p = 0.0168$) and ‘ensure that 1 citizen experiences less nuisance from traffic ($p = 0.0160$).

4. Discussion

4.1. Key results & limitations

This study explores the extent to which the Public WTP approach can be used to obtain willingness to pay metrics for 9 social impacts of transport policies of the Transport Authority Amsterdam (TAA). We observe that participants assign a significant value to all nine social impacts and identify significant Public WTP metrics for all the impacts in the MXL model (95 % confidence level). In the MNL model, Public WTP metrics were significant for all except two impacts, namely 'reduction of delays' and 'citizens experiencing nuisance from traffic'.

Our results show that participants particularly value the outcome that more people can reach key facilities within 15 min by public transport, bicycle, car or walking and they assigned a relatively low value to preventing delays. This suggests that citizens prioritize accessibility over mobility. Moreover, participants assign a very low value to reducing nuisance from transportation. A possible explanation for the low Public WTP assigned to nuisance reduction is that people may feel that nuisance is simply part of living in a highly urbanized area such as Amsterdam. We explored this possible explanation in the Latent Class (LC) choice model but did not find conclusive evidence. That is, we did not obtain significant results about how participants' preferences for reducing nuisance differ depending on whether they live in urban or rural areas (see supplementary material A). Another explanation for the low Public WTP estimate for nuisance reduction is that the attribute was formulated too generically, causing respondents to not assign any importance to it when making choices. Further research might therefore be conducted to investigate the preferences of citizens living in different environments regarding the reduction of various kinds of nuisance.

Our results also indicate the total Public WTP for pursuing modal shift from car to public transport, bike or foot is very high: 459 euro for 1 daily trip by public transport, bike or foot instead of by car. This suggests that policy makers can invest 459 euro to ensure that one traveller switches from using a car to a sustainable mode throughout the year. One of the reasons for this high Public WTP might be that our study included attribute levels in which a very large number of trips were shifted from car to bike, foot and public transport (25,000; 50,000; 75,000; 100,000) for which respondents' Public WTP is non-marginal. The Public WTP could turn out to be much lower (or zero) if we had used smaller attribute levels such as '1 extra trip by public transport, bike or foot' instead of by car per year, 5 extra trips, 10 extra trips etc. For this reason, additional Public WTP experiments investigating the social impacts included in this study with different impact sizes are needed to establish to what extent these results can be generalized over time and in different contexts. Moreover, we recommend conducting more research into framing effects in general. For instance, it would be worth investigating the extent to which the Public WTP metrics change when we change the attribute 'number of citizens who dare to cycle independently' to 'number of children who dare to cycle independently', or when we change the attribute 'number of citizens that can reach important facilities within 15 min by public transport, bike, car or by foot' to 'number of citizens that can reach important facilities within 15 min by bike or foot', or when we change the attribute 'how many people can access, understand and use public transport' into other operationalizations of social exclusion (see Stanley, 2024). Further research to investigate if the Public WTP approach should also seek to obtain WTP metrics for other effects than the nine social impacts under scrutiny in this study, such as spatial equality and social inclusion.

To further improve the insights derived from Public WTP experiments in transport appraisal studies, another important avenue for further research is to investigate to what extent Public WTP differs between citizens with different sociodemographic characteristics. The Latent Class (LC) analysis we conducted only provides some indications about the existence of heterogeneity in taste parameters between different subgroups (see supplementary material A), but no clear patterns could be observed in the preferences of different subgroups that were relevant for the Transport Authority Amsterdam (e.g. based on age, gender, education level, how respondents perceived their financial situation and their access to different modalities). Hence, an important limitation of the MNL and MXL results presented in this paper is that these choice models weigh individuals' preferences through a utilitarian social welfare function which assumes that an equally large weight should be attached to everybody's utility regardless of their current situation. A critique of this approach is that it ignores distributive justice considerations that are important for political decision-making (e.g. Martens, 2017). As we do not have data on people's household income it is difficult to obtain Public WTP measures for alternative social welfare functions (Adler, 2012; Atkinson, 1973). Hence, we recommend further research projects to also ask for people's household income. Moreover, better data-collection might help to estimate more fine-grained LC models. But because the information requirements for establishing class-specific weights are high (Fluerbay & Abi-Rafeh, 2016) and data collection is often constrained by practical reasons, a more pragmatic approach could be to estimate MNL or MXL models for specific subgroups which policymakers consider to be most relevant such as income level and car dependency (Stanley & Stanley, 2017). Another interesting avenue for further research could be to ask citizens which social welfare function they find most appropriate in a specific context. Perhaps, participants are of the view that the weighting of citizens' utility changes should not only be differentiated based on household income, but on other dimensions such as car dependency (see Stanley & Stanley, 2017).

4.2. Policy implications

As scholars have continuously pointed out, an important normative question that researchers and practitioners should ask themselves when conducting CBA is how to value social gains and losses (Nash et al., 1975; Nyborg, 2014; Sen, 2000). Ever since CBA was first developed, most applications have relied on Private WTP, despite several shortcomings. This study suggests one shortcoming of this approach – that many social impacts cannot be monetized – can be ameliorated through the Public WTP approach, since we obtained monetary values for several social impacts that are difficult to value through Private WTP. This evidence further strengthens the case for the necessity to ask why and when we should use the Private WTP approach or the Public WTP approach. Two approaches to dealing with this question can be distinguished in the literature.

One approach is to make a distinction between the assessment of public goods and private goods. For instance, Nash et al. (1975) argue that Private WTP is a good approach for valuing activities taking place in the private sector, but that activities taking place in the public sector should be valued differently. Sen (2000) makes a similar distinction, but he argues that market-based valuation also has merits in the case of many public projects, particularly for providing sensitivity to individual preferences which can be relevant for efficiency considerations. However, applied to social (e.g. equity) and environmental impacts, Sen (2000) argues valuation based on market analogies is limited and that therefore, CBA should be extended with other valuation approaches. The Public WTP might be a viable alternative in this regard, but extending CBA with alternative valuation approaches might be criticized for valuing different goods in an inconsistent way (Nash et al., 1975).

Another approach advocated in the literature is to show policy makers how the final indicators of a CBA are affected by both the Private WTP and Public WTP approach through conducting a 'normative sensitivity analysis' (e.g., Boadway, 2006; Kaplow et al., 2010; Mouter, 2018; Nash et al., 1975). In such a sensitivity analysis, policy makers can be presented with the CBA outcomes based on the Private WTP approach as well as the Public WTP approach. Consequently, the CBA result may differ depending on the value judgments adopted. If a proposed government policy is positively (negatively) evaluated through both the Private WTP approach and the Public WTP approach, then politicians

Table 8
Total WTP metrics that can be used in practical applications.

	Total Public WTP (838,000 households)	For which policies or policy packages can this metric be used?
10,000 citizens can reach work within 45 min by public transport, bike, car or by foot	€ 29,232,191	Policies that result in an increase or decrease of at least 5000 citizens who can reach their work within 45 min.
1000 citizens can reach important facilities within 15 min by public transport, bike, car or by foot	€ 16,848,343	Policies that result in an increase or decrease of at least 1000 citizens who can reach their important facilities within 15 min.
Reduction of 10 delays of at least 15 min for all citizens of the region	€ 5,720,233	Policies that affect delays across the whole region.
Reduction 10 traffic fatalities per year	€ 64,932,379	Policies that result in an increase or decrease of at least 5 traffic fatalities per year.
Reduction 100 severe injury per year	€ 45,954,329	Policies that result in an increase or decrease of at least 50 traffic fatalities per year.
1000 citizens dare to cycle independently	€ 14,169,646	Policies that result in an increase or decrease of at least 1000 citizens that dare to cycle independently.
100,000 extra trips by PT, bike or foot instead of by car per day	€ 46,301,393	Policies that result in an increase or decrease of at least 25,000 trips by public transport, bike or foot instead of by car.
100,000 citizens experience less nuisance from traffic	€ 17,290,060	Policies that result in an increase or decrease of at least 40,000 citizens experiencing nuisance from traffic.
50,000 extra citizens can access, understand and use public transport	€ 83,800,000	Policies that result in an increase or decrease of at least 15,000 citizens that can access, understand and use public transport.

can be confident in deciding (not) to implement the proposed policy. However, when both approaches produce conflicting recommendations, politicians may reasonably disagree about the social welfare effect of a government project. In that case, they could engage in a debate on the reasonableness of different sets of judgments. This approach lines up with the argument of Nyborg (2014) that in a democracy, elected politicians should be tasked to make ethical decisions and this should not be the task of economists or civil servants. It is also in line with the observation of Mouter (2017) that politicians prefer that all calculations in CBAs are done in an impartial way but also want the inherent partiality of the method to be recognized by making it explicitly clear which value judgments are made.

When policy makers in metropolitan regions with similarities to the Amsterdam region want to start using the WTP metrics for the appraisal of transport policy packages we recommend to use the effect dimensions that are in the range of the attribute levels that are included in this study. To assist policymakers in doing so, we reformulated the Public WTP metrics presented in Table 5 to metrics related to the effect dimensions we used in this study (see Table 8).

5. Conclusion

Public willingness to pay (WTP) experiments have been introduced to value impacts of government policies that are difficult to monetize. This study investigates the extent to which the Public WTP approach can be used to obtain willingness to pay metrics for nine social impacts of transport policies Transport Authority Amsterdam. We conducted five Public WTP experiments in which respondents were asked to choose between alternative transport policies trading of the nine social impacts against a uniform tax increase. We establish that participants assign a significant value to all the nine social impacts and identify Public WTP metrics for all these impacts. This finding suggests that the critique on CBA that non-monetized impacts have a weak position (e.g., Beukers, 2015; Handy, 2008; Hickman & Dean, 2018; Mackie et al., 2014; Mouter et al., 2015; Nicolaisen et al., 2017) must potentially be reframed from 'it is difficult to monetize all relevant impacts of transport projects' to 'it is difficult to monetize all relevant impacts of transport projects using the private willingness to pay approach'. Moreover, this study shows that participants particularly valued that people can reach key facilities within 15 min by public transport, bicycle, car or walking and they assigned a relatively low value to preventing delays. This suggests that citizens prioritize accessibility over mobility.

CRediT authorship contribution statement

Martijn Olivier de Vries: Writing – original draft, Validation, Methodology, Formal analysis, Conceptualization, Writing – review & editing, Visualization, Project administration, Investigation, Data curation. **José Ignacio Hernández:** Writing – original draft, Methodology, Data curation, Writing – review & editing, Software, Formal analysis. **Niek Mouter:** Writing – review & editing, Validation, Investigation, Formal analysis, Conceptualization, Writing – original draft, Methodology, Funding acquisition, Data curation.

Declaration of competing interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests:

Niek Mouter reports having stocks and Martijn Olivier de Vries reports having certificates in the private company Populytics, a start-up of Delft University of Technology, which commercially applies the discrete choice experiments and other kinds of participatory policy appraisals.

If there are other authors, they declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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